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Standards Applicable to Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities Under RCRA (Resource Conservation and Recovery Act), Subtitle C, Section 3004
Interim Status Standards for Landfills (40 CFR 265, Subpart N)

(U.S.) Environmental Protection Agency
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BACKGROUND DOCUMENT

STANDARDS APPLICABLE TO OWNERS AND OPERATORS OF HAZARDOUS WASTE TREATMENT, STORAGE, AND DISPOSAL FACILITIES UNDER RCRA, SUBTITLE C, SECTION 3004

Interim Status Standards for Landfills
(40 CFR 265, Subpart N)

This document (ms. 1941.15) provides background information and support for EPA's hazardous waste regulations

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This document is one of a series providing support for regulations issued by the U.S. Environmental Protection Agency (EPA) under Subtitle C of the Resource Conservation and Recovery Act (RCRA). The regulations represent the initial effort for nationwide control of hazardous waste from point of generation, through transportation, treatment, and storage, to point of ultimate disposal.

This document covers standards applicable to hazardous waste management facilities, specifically, it provides the rationale for the standards for landfills with "Interim Status"--that is, they were in existance on November 19, 1980 (the effective date of the regulations), have notified EPAof their activities, and have applied for a permit, which has not yet been processed (Subpart N).

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I. INTRODUCTION

A. Purpose and Scope of the Land Treatment Background Document

Pursuant to authorities in Subtitle C of the Resource Conservation and Recovery Act of 1976, EPA has promulgated interim status standards for treatment and disposal of hazardous waste in land treatment facilities. This document provides the rationale for the standards which have been established.

Draft regulations on this subject were proposed for public comment on December 18, 1978 (43 FR 58946-59028). Numerous comments on this proposal were received at public hearings and as written responses. Synopses of the comments and the Agency responses to all of the comments received relative to the final interim status standards for land treatment are addressed in Part IV of this document.

This document is divided into four parts, followed by references and appendices. Part I, Introduction, describes the purpose and scope of this document, the legislative authority for the regulations, and definitions used in their development. Part II, Need for Regulation, explains the basic public health and the environmental rationale supporting a need for regulation in this area. Part III, Synopsis of the Proposed Regulation, summarizes the regulation as proposed. Part IV, Comment Analysis and Regulation Rationale, comprises the major portion of this document. It presents the comments received on the proposed regulations and the Agency's responses to those comments. These responses reflect the rationale used in establishing the proposed standard and the final rationale for maintaining that standard or altering it in view of the comments received or any new information which has been obtained. It then presents the final regulatory language resulting from this analysis.

B. RCRA Mandate for the Regulation

Section 3004 of Subtitle C of the Resource Conservation and Recovery Act (RCRA) of 1976 (P.L. 94-580), requires the Administrator of the Environmental Protection Agency to promulgate regulations establishing standards, applicable to owners and operators of hazardous waste treatment, storage, and disposal facilities, as may be necessary to protect human health and the environment. Section 3004 further requires that these standards are to include, but need not be limited to, requirements respecting: (1) location, design, construction, and operation of such facilities; (2) treatment, storage, or disposal of all hazardous waste received pursuant to such operating methods, techniques, and practices as may be satisfactory to the Administrator; and (3) maintenance of records of hazardous wastes treated, stored, or disposed, along with satisfactory reporting, monitoring, and inspection. Land treatment facilities used for the treatment or disposal of hazardous wastes are covered by this mandate.

Subtitle C of the Act, specifically §3005(e), also provides for a period of interim status to owners and operators of existing facilities for treatment, storage, and disposal of hazardous wastes. Interim status applies to that period between the effective date of the Section 3004 treatment, storage, and disposal regulations and the date on which a permit is issued pursuant to Section 3005 of the Act. Section 3005 provides that after the effective date of the regulations, treatment, storage, and disposal shall not be carried out except in accordance with a permit issued pursuant to Section 3005. However, it also establishes that persons who have applied for a permit, but whose applications have not been acted on by the time the regulations become effective, shall be granted interim status.

A complete rationale for establishing interim status standards and responses to the public comments on that subject are presented in the background document entitled "General Issues Regarding Interim Status Standards."

This background document on interim status standards for land treatment addresses the standards applicable to land treatment facilities during the time a facility is granted interim status.

C. Key Definitions

The following are key definitions pertinent to the standards applicable to land treatment facilities. Definitions that have changed as a result of public comment or internal Agency decisions are footnoted and the rationale for the changes are referenced.

"Active portion"* means that portion of a facility where treatment, storage, or disposal operations are being or have been conducted after the effective date of Part 261 of this Chapter and which is not a closed portion. (See also "Closed Portion" and "Inactive Portion.")

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* Revised definition, see background document on definitions.

"Constituent" or "hazardous waste constituent" means a constituent which caused the Administrator to list the hazardous waste in Part 261, Subpart D, of this Chapter, or a constituent listed in Table 1 of 261.24 of this Chapter.

"Food-chain crops" means tobacco, crops grown for human consumption, and crops grown for feed for animals whose products are consumed by humans.

"Ground water" means water below the land surface in a zone of saturation.

"Hazardous waste" means a hazardous waste as defined in §261.3 of this Chapter.

"Incompatible wastes"* means a hazardous waste which is unsuitable for:

(i) Placement in a particular device or facility because it may cause corrosion or decay of contaminant materials (e.g., container, inner liners, or tank walls); or

(ii) Commingling with another waste or material under uncontrolled conditions because the commingling might produce heat or pressure, fire or explosion, violent reaction, toxic dusts, mists, fumes, or gases, or flammable fumes or gases.

(See Part 265, Appendix IV, of this Chapter for examples.)

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* Revised definition, see background document on definitions.

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"Land treatment facility"[†] means a facility or part of a facility at which hazardous waste is applied onto or incorporated into the soil surface; such facilities are disposal facilities if the waste will remain after closure.

"Run-off" means any rainwater, leachate, or other liquid that drains over land from any part of a facility.

"Run-on" means any rainwater, leachate, or other liquid that drains over land onto any part of a facility.

"Unsaturated zone" or the "zone of aeration" means the zone between the land surface and the water table.

II. NEED FOR REGULATION

A. How Land Treatment Achieves Environmental Control

Land treatment is a waste management practice that involves application of waste onto the soil and/or incorporation of the waste into the soil, usually in thin layers or applications. Land treatment facilities frequently utilize common farm practices such as tilling, contouring, and erosion control techniques. Farm equipment is often used to plow or disk the waste into the soil, and nitrogen and phosphorus fertilizers are often added to enhance microbial degradation of the waste.

The soil in a land treatment facility functions as both a biological treatment medium and a physical-chemical filter medium. The efficacy of the soil as a waste treatment medium depends upon maintaining conditions that promote and enhance the survival of soil microorganisms. In addition, certain physical parameters of the soil must be maintained in order to maximize the physical-chemical immobilization of inorganic waste constituents.

[†] Formerly "landfarm," revised definition, see discussion in Part IV(A)(1) of this document.
New definition, see background document on definitions.

Theoretically, the soil has unlimited capacity to biodegrade nonpersistent organic waste constituents as long as acceptable conditions are maintained. In contrast, the capacity of the soil to physically-chemically filter and immobilize inorganic and persistent organic waste constituents, even with careful management, is finite. Ultimately, any soil used as a chemical-filter medium will become saturated with nondegradable waste constituents. Such a dynamic treatment system requires careful management during operation, as well as long-term monitoring and maintenance if contaminants are to be prevented from migrating to surface or ground water. If appropriate operating and design parameters are followed, land treatment can be an environmentally acceptable method for treating certain types of hazardous wastes.

B. Potential and Actual Environmental Damages

Land treatment of hazardous waste is a relatively new waste management practice and is not in widespread usage. Knowledge about conditions necessary to promote biodegradation of wastes and knowledge about soil attenuation capacities is still being developed as practical experience is gained in the field. Information on long-term effects of land treatment is virtually nonexistent. EPA is not aware of any studies of land treatment facilities which have been completed and closed. At currently operating land treatment facilities, environmental monitoring has often been absent, inadequate, or inappropriate.

Recent State requirements frequently stress groundwater monitoring and rarely include unsaturated zone monitoring (i.e., soil and soil-pore water monitoring). The consequence of using groundwater as the sole measure of environmental performance is that contamination will not be detected until it reaches ground water. Remedial measures to prevent further contamination of the ground water, once contamination has been detected, would be extremely difficult.

The absence of air emission monitoring requirements for hazardous waste land treatment facilities has been documented by a recent study.[1] According to the recent study, there is no specific mention of protection of air resources at land treatment facilities in any State regulation. The study concludes that there is a strong need for national regulations which recognize the potential for air pollution from land treatment.

Because of the lack of long-term experience, the limited use of land treatment as a waste management practice, and the lack of appropriate environmental monitoring, there is very little information on actual public health and environmental impacts of land treatment. Although mechanisms for contamination of the surface water, air, and ground water clearly exist, there are few documented damage cases involving hazardous waste land treatment. The following is a discussion of the actual and potential avenues of contamination and documented damage incidents that have been associated with hazardous waste land treatment.

1. Surface Water Contamination

Surface water situated near a land treatment site may be subject to pollution from contaminated run-off resulting from erosion of the soil-medium or dissolution of wastes from the active portions (i.e., areas to which waste has been applied). Because the process of land treatment introduces and concentrates wastes in the soil surface, run-off water may be contaminated to the extent that it will impact certain trophic levels in the aquatic ecosystem.[2]

One of the few damage incidents reported in the literature involved the erosion of contaminated soil from a land treatment facility as a result of a rainstorm occurring soon after an oily sludge was applied. Erosion of the soil-waste medium by run-off carried contaminants to an onsite lake, resulting in a fish kill.[3]

2. Air Emissions

A recent EPA study that evaluated emission control criteria for hazardous waste management facilities describes one air-related damage incident resulting from land treatment of oil refinery waste.[1] In this case, neighbors complained of odors and there were some reports of damage to paint on nearby houses.

Although there are few documented cases of air pollution from land treatment, the potential for release of significant quantities of pollutants to the atmosphere exists. The disposal of oily-type wastes provides an excellent example of air pollution potential. Gases and odors generated increase initially during spreading operations and subside as microbial decomposition occurs. However, in the weathering (spreading) method of disposing of leaded gasoline storage tank wastes, the vapors can be inhaled or absorbed through the skin. At the levels of organically-bound lead (20 to 200 ppm) encountered in the storage tank sludge, a potential lead-in-air hazard could occur during the weathering process.[4]

Since many of the oily wastes have a high water content, they are commonly applied to the land by spraying. This would allow for aerosol formation and release of waste constituents. In addition, air pollution can occur through direct volatilization of constituents contained in the waste after it has been spread on the land. Again, because of the high water content of many oily-type wastes, initial disposal often involves allowing the water to evaporate from the waste prior to mixing with the soil. During this period of time, all constituents of equal or higher volatility than water will be released to the atmosphere, and other waste constituents will also evolve due to co-solvent processes.[1]

A third mechanism for air pollution is by entrainment of particulates through wind erosion. This latter mechanism may become increasingly important throughout the life of an active land treatment site. Since most oily wastes contain trace elements, these tend to accumulate in the soil with each additional application of waste material. The initial particles released to the atmosphere through wind erosion for a new site will contain low concentrations of trace elements; however, several years after a site has been in operation, the concentration of trace elements in soil particles will be much higher.[1]

In addition to the potential for creating localized concentrations of air pollutants which are potentially hazardous to health, there is a real potential for significantly reducing air quality through photochemical reactions of constituents evolving from the disposal site. This may be of particular concern in areas where ambient concentrations of photochemical oxidents are already high, such as in parts of California.[1]

3. Ground-Water Contamination

The land treatment of non-hazardous waste has resulted in contamination of ground water by nitrates and phosphates which were present in the waste or added as fertilizer.[5] Hazardous waste land treatment has the same potential consequences, though EPA is not aware of any documented ground-water contamination incidents resulting from the practice. This lack of documentation should not be interpreted to mean that hazardous waste land treatment poses no threat to the ground water. The potential for contamination may be greater for hazardous than nonhazardous wastewater and sludge, because the contaminants are often present at greater concentrations.[2]

The paucity of data available on land treatment-related ground-water cases may be a result of inadequate monitoring and the time required for problems to manifest themselves.

In light of the many avenues for environmental damage from land treatment, the Agency strongly believes that regulation of this practice is necessary. A land treatment facility is a dynamic treatment system requiring careful operation and long-term monitoring and maintenance. Without proper regulatory control, land treatment can cause significant environmental damages.

III. SYNOPSIS OF THE PROPOSED REGULATIONS

The regulations proposesd on December 18, 1978, included certain standards applicable specifically to land treatment facilities (§250.45-5) and standards relevant to all facilities (§250.42, 250.43, and 250.45). Those portions of the above standards applicable during interim status were proposed in §250.40(c)(2).

The full set of proposed land treatment regulations (§250.45-5) addressed the following:

- restrictions on land treatment of ignitable, reactive, volatile, and incompatible waste
- restriction against contact of a land treatment facility with navigable water
- restrictions against location of the treated area within five feet of the high water table or within 500 feet of a public or private water supply
- specifications regarding the soil types acceptable for a land treatment facility
- minimization of erosion, landslides, and slumping, including a maximum slope of five percent
- sealing of caves and wells connected to the subsurface environment within a land treatment facility
- maintenance of a soil pH of at least 6.5
- restriction on the zone of incorporation from becoming anaerobic
- restrictions on waste application when the soil is saturated with water or when the soil temperature is below 0°C
- restriction on application rates of phosphorus and nitrogen

- soil monitoring, including determination of background conditions at three times the zone of incorporation, periodic sampling at that depth to determine if background levels have been exceeded, corrective action if a significant increase over background has occurred.

- restriction on the growth of food-chain crops on the treated area of a land treatment facility.

- requirement that at closure, the soil of a land treatment facility, if it meets the characteristics of a hazardous waste, be removed and managed as a hazardous waste. A variance to this requirement provided that the land treatment facility could be closed in accordance with landfill closure requirements if the owner or operator could demonstrate to the Regional Administrator that long-term environmental protection equivalent to a landfill could be achieved.

The interim status standards specific to land treatment, proposed in §250.40(c)(2)(XV) of the December 18, 1978, regulations, included only requirements for closure. The application of the closure requirements also included by reference, the soil monitoring requirements of the full set of proposed land treatment regulations. Thus, the proposed interim status standards required that:

- background soil conditions of the land treatment facility be determined by soil analysis in the zone of incorporation (new facility) or in similar local soils (existing facility).

- at closure, if the soil of a land treatment facility meets the characteristics of a hazardous waste, it either must be returned to its preexisting (background) condition, or must be removed and managed as a hazardous waste. A variance to this requirement provided that the land treatment facility could be closed in accordance with landfill closure requirements if the owner or operator could demonstrate to the Regional Administrator that long-term environmental protection equivalent to that for a landfill could be achieved.

Additional interim status standards were proposed which were applicable to all facilities. Waste analysis and recordkeeping and reporting requirements are included in this category. As proposed, these interim status requirements included:

- waste analysis to determine the hazardous constituents and properties of the waste prior to initial disposal.
- verification of certain properties of each shipment of waste received; and periodic, comprehensive analysis of waste if there were indications of changes in composition.
- recordkeeping and reporting, including an operating log, a record of the quantity and description of each waste handled at the facility, locations where each waste is treated or disposed and the method and dates of treatment or disposal, the results of the waste analysis performed, monitoring data, reports of visual inspections, and records of incidents requiring initiation of a contingency plan.

Portions of the proposed waste analysis and recordkeeping regulations, including revisions in responses to the comments, are included in the general facility requirements of the interim status regulations and discussed in the background documents dealing with waste analysis and with manifest, recordkeeping, and reporting. The rationale for those portions which have not been included in the land treatment interim status standards are dealt with in this document.

Although not proposed as interim status standards, the Agency has decided to include other portions of the full set of proposed standards in the interim status regulations because they serve important environmental objectives, and generally meet the criteria for inclusion in interim status. The Agency feels that these requirements conform to the criteria described in the background document entitled "General Issues Regarding Interim Standards" for in inclusion in interim status standards. These additional requirements include:

- control of run-on and run-off to active portions of the facility

- restrictions on land treatment of ignitable, reactive, and incompatible wastes.
- restriction on the growth of food-chain crops on the treated area of a land treatment facility

Comments received relevant to the above requirements are addressed in the next section of this document.

IV. COMMENT ANALYSIS AND REGULATORY RATIONALE

A. Changes in Terminology/Definitions

1. Changes in Terminology

The Agency has decided to use the term "land treatment facility" in place of "landfarm." Although no public comments were received suggesting a change in terminology, the Agency felt it was desirable to use a term which more accurately describes the purpose of this particular waste management practice. The terms "landfarm" and "landfarming" misleadingly imply a connection between hazardous waste disposal and crop production or soil beneficiation. The term "land treatment," in contrast, implies that the land or soil is used as a medium to treat hazardous waste. This meaning, which is now reflected in the regulations, is consistent with the Agency's philosophy that the application of hazardous waste to the soil is a waste management practice reserved for those waste streams that are treatable in a soil system. Any benefit derived from land treating hazardous waste, beyond that of treatment, is incidental and is not considered an appropriate justification for allowing the practice. Treatment, in the context it is used here, means a reduction in the hazard posed by the waste. This reduction occurs as a result of alterations in the chemical state of the waste via biological and

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chemical interactions occurring in, and enhanced by the soil.

The Agency acknowledges that the soil has the capacity to filter and dilute waste. However, these physical mechanisms provide little or no net reduction in hazard if they do not alter the chemical state of the waste. Consequently, the use of the soil solely as a filtration or dilution medium is not considered appropriate for land treatment.

2. Changes in Definitions

The Agency proposed a number of definitions, unique to land treatment, in the December 18, 1978, regulations. As a result of comments received and changes made to the proposed regulations, some of these definitions have changed or have been deleted. Below is a discussion and rationale for any changes that were made.

a. "Attenuation"

(i) Proposed definition

"Attenuation means any decrease in the maximum concentration or total quantity of an applied chemical or biological constituent in a fixed time or distance traveled resulting from a physical, chemical, and/or biological reaction or transformation occurring in the zone of aeration or zone of saturation.

(ii) Change made

"Attenuation" has been deleted from the ISS definitions.

(iii) Rationale for change

The regulation containing the term "attenuation" is not part of the interim status land treatment regulations.

b. "Fertilizer"

(i) Proposed definition

"Fertilizer" means any substance containing one or more recognized plant nutrient(s) which is used for its plant nutrient content, and which is designed for use or claimed to have value in promoting plant growth.

(ii) Change made

"Fertilizer" has been deleted from the ISS definitions.

(iii) Rationale for change

"Fertilizer" was not used in the proposed regulations but it did appear in the background document on landfarming. The Agency has decided to define only those terms needing definition, that appear in a regulation. It was therefore an oversight to identify "fertilizer" in the proposed regulations.

c. "Landfarming of a Waste"

(i) Proposed definition

"Landfarming of a waste" means application of waste onto land and/or incorporation into the surface soil, including the use of such waste as a fertilizer or soil conditioner. Synonyms include land application, land cultivation, land irrigation, land spreading, soil farming, and soil incorporation.

(ii) Change made

The terminology and definition have been revised. The revision is as follows: "Land treatment facility" means a facility or part of a facility at which hazardous waste is applied onto or incorporated into the soil surface; such facilities are disposal facilities if the waste will remain after closure.

(iii) Rationale for change

The Agency, besides changing the terminology from landfarming to land treatment, has decided to revise the definition of land treatment so that it is the facility, as well as the practice occurring at that facility, that is defined. As previously discussed, the Agency feels that the new terminology and revised definition more accurately describe the purpose of this particular waste management practice. The term "landfarming" misleadingly implies a connection between hazardous waste disposal and crop production or soil beneficiation . The term "land treatment" in contrast implies that the land or soil is used as a medium to treat hazardous waste. Any benefit derived from land treating hazardous waste, beyond that of treatment, is incidental and is not considered an appropriate justification for allowing the practice.

Treatment, as it applies to land treatment, is considered to be a reduction in the hazard posed by the waste as a result of biological and/or physical-chemical soil-waste interactions. This interpretation of treatment is intended to promote the concept that land treatment is a waste management practice reserved for waste streams which are not treatable in a soil system. The application of waste streams which are not treatable in the soil can only aggravate the hazard posed by the waste.

The synonyms included in the proposed definition have been dropped. The Agency feels that each of these terms may have common uses or connotations which are different from the definition of land treatment and, thus, should not be used as synonyms.

The Agency has added a clause to the definition which defines land treatment facilities as disposal facilities if the waste applied to the site remains after closure. This addition is necessary because land treatment facilities involve both treatment and disposal. The Agency considers the practice to be predominantly treatment but realizes that certain waste constituents (e.g., heavy metals), even if they are in low concentrations in the waste, will accumulate in the soil.

d. "Soil conditioner"

(i) Proposed definition

"Soil conditioner" means any substance added to the soil for the purpose of improving the soils physical properties by increasing water content, increasing water retention, enhancing aggregation, increasing soil aeration, improving permeability, increasing infiltration, or reducing surface crusting.

(ii) Change made

"Soil conditioner" has been deleted from the ISS definitions.

(iii) Rationale for change

The rationale for deleting "soil conditioner" from the definitions is the same as for "fertilizer."

E. "Treated Area of a Landfarm"

(i) Proposed definition

"Treated Area of a Landfarm" means that portion of a landfarm that has had hazardous waste applied to it,, to include the zone of incorporation.

(ii) Change made

"Treated Areas of a Landfarm" has been deleted from the ISS definitions.

(iii) Rationale for change

The term "Treated Area of a Landfarm" has been replaced with the term "Active Portion." "Active Portion" means that portion of a facility where treatment, storage, or disposal operations are being or have been conducted after the effective date of Part 261 of this Chapter and which is not a closed portion.

The Agency has chosen to use active portion in place of treated area because the use of the former for all facilities makes use of the latter unnecessary. Additionally, the definition of active portion specifically defines, in a temporal sense, those parts of the facility which are subject to Subtitle C regulation.

F. "Zone of Incorporation"

(i) Proposed definition

"Zone of Incorporation" means the depth to which the soil on a landfarm is plowed or tilled to receive waste.

(ii) Change made

"Zone of incorporation" has been deleted from the ISS definitions.

(iii) Rationale for change

Due to changes made to the soil monitoring regulations, "zone of incorporation" is no longer used.

B. General Comments Relevant to the Interim Status Standards

Some comments were received that relate to the land treatment regulation as a whole, rather than to a particular standard. These comments are addressed below, followed by comments on specific parts of the regulation.

1. Issue: Should land treatment be allowed as a method to manage hazardous waste?

Comment was received that the proposed EPA regulations would not protect public health and the environment nor prevent destruction of valuable land, and that no modification to the regulations could be envisioned which would make land treatment acceptable. No reasons were given for this position.

Response: The literature on land treatment reveals that a properly operated land treatment facility can provide environmentally sound disposal through the physical, chemical, and biological interaction of the soil and the waste.[2,6,7,8,9] These interactions result in degradation of organic wastes and immobilization of metallic contaminants through physical-chemical interactions with the soil.

The discussion of soil monitoring, later in this section, describes evidence that shows that in a properly designed and operated land treatment facility, migration of waste contaminants beyond the depth to which the waste is incorporated into the soil should be minimal.

EPA recognizes, as was discussed in Part II of this document, that land treatment relies less on physical containment than other disposal methods. Also, the concept of spreading hazardous waste on the land may offer more opportunity for wastes to enter the environment than other land disposal options.

EPA has addressed these issues by promulgating performance oriented monitoring requirements that will quickly indicate any failure of the land treatment facility to perform in an environmentally sound manner. This is the basis of the unsaturated zone monitoring requirements of the interim status regulation. The unsaturated zone monitoring requirements will allow the owner or operator, or the Regional Administrator to quickly identify any waste migration that would post a potential threat to public health and the environment through ground-water contamination.

The interim status regulations also include standards to prevent surface water contamination and specify certain operating and design and closure requirements to ensure that facility operation will not contaminate ground water or surface water or otherwise threaten public health. The Agency is confident that these regulations, having undergone a thorough public and Agency review, will be fully protective of public health and the environment.

2. Issue: Should land treatment of highly toxic wastes or environmentally persistent organics be allowed?

The preamble to the proposed regulations suggested that environmentally persistent organics should not be land treated in concentrations that would result in accumulation of these organics in the soil. The practice was not banned because of the difficulty in defining "environmentally persistent organics." Comment was requested on how this characteristic might be defined generically, and whether the burden should be shifted to the owner or operator to show than an organic applied in a certain concentration will be degraded within a certain amount of time.

Commenters made the following points about this issue:

- Prior to land treatment of persistent organics, owners or operators using land treatment should be required to show that the half-life of persistent organics be one year or less before land treatment is allowed.
- A definition of persistent organics should be included as part of the regulations under Section 3001 of the Act.
- The burden of proof that such materials are amenable to microbial action in soil should be on the owner or operator.
- There should be no prohibition on environmentally persistent organics, since the closure requirements of the regulations (removal of contaminated soil from the land treatment facility) and soil monitoring will sufficiently discourage their land treatment.

- Environmentally persistent organics should not be land treated because within days or weeks after application, these toxins could begin entering the environment through erosion.
- The definition of environmentally persistent organics should include a half-life related to the time the wastes are incorporated into the land (e.g., 50% of the waste must degrade within one year from the date it is applied).
- Land treatment of materials which are banned from use, because they are considered dangerous in even minute quantities, should be disallowed in a land treatment facility. The potential for dispersion of such materials by wind and surface water run-off is a major concern. If such materials are land treated, massive environmental and public protest will ensue in light of "LD-50 values of pesticides on fish and their penchant for bioaccumulation."

Response: It is evident from the above comments on environmentally persistent organics that there was no clear public concensus on this issue. Given the diversity of these comments and the fact that the Agency does not feel that it has sufficient information at this time to establish any prohibitions on land treatment of environmentally persistent wastes, the interim status standards do not address those wastes. Similarly, the Agency lacks sufficient information at this time to support restrictions for land treatment of "highly toxic wastes."

However, the Agency believes that it is important to further investigate the land treatment of environmentally persistent and highly toxic wastes to determine if special restrictions should be applied. The Agency plans to deal with this issue in future regulations on land treatment.

3. Issue: The land treatment regulations are not adequate with respect to monitoring and testing protocols

A commenter pointed out that because of potential dangers associated with landspreading of sewage sludge and other wastes, EPA should adopt stronger monitoring and testing protocols.

Response: The commenter did not suggest alternative monitoring and testing (presumably waste testing) procedures, nor were reasons given that the proposed procedures did not appear to be adequate. There was no elaboration on the "potential" dangers referenced. Specific comments received on the proposed soil monitoring procedures and responses to them are presented later in this section. Comments on general waste analysis procedures are presented in the background document dealing with that subject.

4. Issue: Opposition to variances in the standards

A discussion of waste analysis requirements specific to land treatment is discussed later in this document in Part IV(c)(2). A commenter suggested that the variances in the proposed land treatment regulations provided too little control and would result in potential danger to ground water and surface water.

Response: The commenter did not indicate specific variances of concern or the reasons that damages might result.

The interim status standards generally do not include regulations containing variances because they require interaction with the Agency as a part of the permitting process.

5. Issue: The regulations should be based on performance requirements rather than operating and design requirements

A commenter pointed out that the technology of land application of complex organic wastes is in its infancy and advances in knowledge are being made rapidly. Therefore, operational standards will limit potential for innovation and advances. It was suggested that performance can adequately be measured by monitoring of soil, ground water, and surface water. The commenter also suggested that although variances are provided in the regulations, it is doubtful that they would actually be granted by the permitting authority.

Response: A number of comments were received on the subject of performance standards versus operating standards. These comments related to all parts of the proposed regulation, including the comment above on land treatment. Under RCRA, EPA is authorized to set both performance and operational standards, depending on the applicability of either approach to the environmental problem being addressed by the regulations.

The Agency believes that pure performance standards for land treatment can result in failure to adequately protect the environment. For example, the standard might require only that the ground water be monitored to ensure no degradation beyond the primary drinking water standards. One failure of this approach would be that numerous organic and some metallic substances

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are placed in land treatment facilities which are not covered at this time by the drinking water standards, but which may cause damage to public health. A second failure is that by the time ground-water contamination is detected in a land treatment facility, the entire soil profile would be contaminated, making removal action difficult and expensive.

However, other performance measures can be constructively employed. The Agency believes that the regulations should use such performance standards where feasible in an effort to provide maximum flexibility to owners or operators. As the commenter suggested, the technology of land treatment is still in an early stage of development, and flexibility in the standards is desirable as long as environmental protection can be maintained.

The changes to the land treatment regulations made as a result of this and other comments reflect increased flexibility. This is particularly true in the key areas of food-chain crops, monitoring, and closure.

6. Issue: Crude oil should be exempted from the land treatment regulations

A commenter suggested that crude oil does not contain concentrations of metals normally found in other waste oils that have been refined or used in industrial processes. The commenter stated that crude oil properly applied adds nutrient to the soil, and that the Bureau of Land Management uses oil field wastes to aid in restoration of rights-of-way.

Response: EPA has no data to substantiate that waste crude oil, which is hazardous under Subpart C of Part 261 can be applied to the land without impacts on the environment. The commenter provided no data or references to substantiate the claims in the comment, except the general reference to the Bureau of Land Management.

The Agency contacted the Bureau of Land Management, Division of Right-of-Way, and learned that they had no knowledge of such an activity within BLM.[10] The BLM regional office dealing with oil and gas surface protection indicated that in some areas, BLM has "recommended" spraying an oil film on sandy areas to prevent blowing of sand. However, pure crude oil, not waste oils, were recommended for this technique.[11] It was also indicated by another BLM regional office that waste oils are commonly used for road oiling to reduce dust.[12]

The above very limited practices are not considered land treatment of waste oils from oil production operations as defined previously since dust control, not waste treatment, is the concern. Unless an area is designated as a hazardous waste land treatment facility, it may not be used for oils classified as hazardous. Furthermore, the Agency believes that the significant issue is not whether waste crude oil has lower concentrations of metals than other waste oils, but whether there is documented evidence that application of that waste, or any waste which fails the test for hazardousness under Part 261 of the regulations, causes no contamination of ground water or surface water when placed in a land treatment facility. Although waste crude oil usually contains lower concentrations of heavy metals than do other waste oils, a combination of high application rates and multiple applications can cause a significant buildup of heavy metals in the soil. Thus, the Agency does not concur with the recommendations of the commenter.

7. Issue: The land treatment regulations are based largely on control of oil wastes, and are inappropriate for other wastes

A commenter stated that EPA's regulations are based on Texas' and Oklahoma's land treatment regulations, which emphasize regulation of oily waste and are, therefore, not applicable to other industrial sludges which may be no more harmful than POTW sludges. The regulations should be revised to consider persistence of contaminants and their availability for crop uptake, and the effect of proper crop management on the leaching potential of contaminants. Iowa's rules on municipal sludge disposal should be used as a model.

Response: EPA's land treatment regulations were developed for all types of hazardous wastes and are not designed around State standards for oily waste. State guidelines of Texas and Oklahoma (see Appendix I) did provide an important data base for the national regulations because of the experience of those States in regulating land treatment facilities. However, the final Federal interim status standards differ substantially from the regulations of either of these States. Furthermore, the Texas guidelines are applicable to all types of industrial wastewaters and sludges, not just oily wastes. EPA also had as an information base for these regulations numerous studies, listed in the references, and the recently promulgated regulations under

Section 4004 of RCRA for landspreading of non-hazardous wastes, including POTW sludge. The background documents, and associated references for the Section 4004 regulations also provide a basis for these regulations.

The Agency does not consider the Iowa regulations for POTW sludge to be totally appropriate for land treatment of hazardous waste. However, the Agency has incorporated into the "Food-Chain Crops" Section of the interim status regulation specific standards for cadmium. While these standards are not identical to the Iowa standards, there is similarity in that they both prescribe a specific loading rate. Iowa's approach controls the amount of waste that can be applied based on the concentration of specific constituents, while the Agency's approach limits only the amount of cadmium that can be applied and not the waste.

The Agency was able to develop specific standards for cadmium because of the significant amount of field experience and research that has been done in this area. This is not the case with other constituents covered by the land treatment regulations under Subtitle C of RCRA. Information is very limited on factors such as attenuation of various substances in the soil and uptake in plants. Without such information, the regulations cannot be tailored to such factors as persistence of contaminants, availability for crop uptake, effect of proper crop management, etc. Hopefully, the Agency will be able to revise the regulations in this direction over time as more information is gained from the regulated community and various research studies on the performance of land treatment facilities.

Additional considerations of the Agency regarding crop growth on land treatment facilities are discussed in the comments on food-chain crops later in this section.

8. Issue: Preserving land is not an RCRA objective

Commenting on the discussion in the preamble to the December 18, 1978, proposed regulations, a commenter noted that a stated objective of the regulations, preventing conversion of huge tracts of productive land to land with limited potential for productive use, was not a reasonable Federal objective under RCRA. Also noted was that the amounts of land involved to date are not "huge" compared to other types of land use, such as housing, wilderness areas, and industrial sites.

Response: This issue relates primarily to the requirements for closure, which are discussed later in this section. EPA would agree that the adjective "huge" overstates the amount of land currently involved in land treatment. However, the practice could grow substantially as a waste management practice, depending on its relative costs compared with other treatment and disposal practices. The Agency believes that it is in the best interests of the nation, and within the Congressional intent that, in development of land disposal practices under RCRA, considerations be given to the impact of those practices on future land use. Also, it would be narrow-sighted and counterproductive to ignore broad Congressional and administration priorities in developing regulations under a particular law. These regulations, however, do not restrict the amount of land which can be used as land treatment facilities, nor are they specifically aimed at controlling land use per se. The Agency is establishing requirements in the land treatment Subpart to assure that the land treatment objective is accomplished, to protect various environmental media (surface water, air, and ground water), and to protect food-chain crops. Land use may be affected by regulations designed to protect public health and the environment.

9. Issue: Land treatment regulations should be based on the degree of hazard posed by the waste

A commenter stated that some hazardous waste can be land treated safely and with beneficial effects to the soil and crops, while other hazardous waste (highly toxic, nonbiodegradable) should not be land treated. Therefore, not all criteria for determining "hazardous waste" for land treatment should be weighed equally.

Response: The commenter offered no examples or specific suggestions relative to the general comment. There were also no data or references provided. Thus, the response must also be relatively general.

Ideally, the Agency would be able to develop a set of detailed, tailored standards for land treatment of various wastes, including acceptable levels of various contaminants in the soil and in crops. Unfortunately, the state-of-the-art of land treatment will not support such regulations. Information is generally not available to "fine tune" the system as proposed. (This is discussed in more detail in response to comments regarding growth of food-chain crops.)

Some waste-class distinctions have been made in the regulations, such as the restrictions on ignitable, reactive, and incompatible wastes.

C. Specific Comments to the Proposed Land Treatment Standards of December 12, 1978

1. Issue: Surface water run-off

a. Proposed regulation

Prior to beginning this discussion it is necessary to briefly describe the new terminology that will be used. The Agency believes that the term "run-off" as used in the proposed regulation concerning the construction of "diversion structures to divert all surface water run-off from the active portions of a facility" was confusing. Therefore the term "run-on" has replaced the term "run-off" in these situations. That is, as used in these regulations, run-on is water which runs onto the active portions of a land treatment facility or landfill from other portions of the facility or from outside of the facility. Run-off is rainwater, leachate, or other liquid which flows from the active portions of a disposal facility.

Requirements for control of surface water run-off and run-on were not included in the proposed interim status standards for land treatment facilities. However, those requirements were specified in the proposed full set of standards in §250.43(b) and (c). These regulations required the owner or operator to construct diversion structures capable of preventing run-on from entering a land treatment facility. A variance to this requirement was allowed where an owner or operator could demonstrate to the Regional Amdinistrator than run-on would not enter the site and come in contact with the hazardous waste. The proposed regulations also required the owner or operator to collect and confine run-off from active portions of the facility to a point source before discharge or treatment.

B. Comments to the Proposed Regulation

The background document for Interim Status Standards for Landfills discusses the proposed General Facilities Standards concerned with discharges from hazardous waste facilities (§250.43(a)), diversion structures for control of run-on (§250.43(b)), and control of run-off from active portions (§250.43(c)).

C. Response to Comments

A discussion of the comments received on the proposed run-on and run-off requirements is presented in the background document on landfills.

In these interim status regulations land treatment facilities will be subject to the same requirements as landfills regarding surface run-on and run-off. Run-on must be diverted away from the active portions of the land treatment facility. Run-off from the active portions must be collected. If the collected run-off is a hazardous waste it must be managed as a hazardous waste. If it is not a hazardous waste it may still need to be analyzed, treated, or otherwise managed to comply with Subtitle D of RCRA or the Clean Water Act.

EPA believes that run-on and run-off controls are necessary at land treatment facilities because this disposal option involves the placement of hazardous waste on or just beneath the soil surface. Because the waste is exposed during the application and incorporation process, the potential for loss via surface water erosion is initially high. During site operation, the potential for run-off to become contaminated is directly related to the frequency and rate of waste application. In the long term, the potential for contaminating run-off is further increased as refractory waste contaminants become concentrated in the surface soil.

The release of dissolved or suspended waste contaminants or contaminated sediment from a land treatment facility can have severe ecological consequences. One damage case, involving contamination of a lake by run-off from an oily waste land treatment facility, has already been documented.[3] At another oily waste land treatment site in Texas, surface run-off from experimental plots were found to contain 30-100 mg/l of oil.[7] The study concluded that "oil and nutrient contents of the rainfall run-off water from the soil cultivation [land treatment] process can be relatively high, and this discharge water should receive treatment before entering public waterways." This conclusion was supported by another study which cited the low tolerance of aquatic organisms to certain trace elements as the major reason for controlling run-off.[2]

The Agency acknowledges that the surface area of the active portions of a land treatment facility will generally be large, relative to the active portions of landfills. Consequently, more extensive run-on diversion structures and run-off collection systems will be needed at land treatment facilities. The overall impact of run-on and run-off controls is expected to be somewhat tempered since most land treatment facilities already have diversion structures and collection systems.[36] The Agency does not anticipate that all the run-off that is collected at land treatment facilities will require treatment prior to discharge. Evidence in the literature suggests that if the waste is thoroughly incorporated into the soil, contamination of run-off can be minimized or prevented. At an oily waste land treatment facility in Texas, Raymond and his co-workers found that after thorough waste incorporation, there was no significant difference between the quality of run-off from experimental and control plots.[37] Agricultural pesticide run-off studies have shown that run-off quality improves with the length of the storm event and with the length of time since the last pesticide application.[2] These phenomena are paralleled in land treatment facilities.

These studies strongly suggest that run-off may need treatment only during certain periods, for example, run-off that is collected at the beginning of a storm event or immediately after waste has been applied. Once wastes have been incorporated into the soil, and the wastes have been degraded or the soil surface stabilized by crusting or vegetation, collected run-off is expected to require little or no treatment.

A 12-month delay for compliance with these regulations is given so that existing facilities may construct new run-off control systems or upgrade existing systems, including those for run-off treatment and disposal.

D. Final Regulatory Language

§265.272 General Operating Requirements [Interim Final]

(a) Hazardous waste must not be placed in or on a land treatment facility unless the waste can be made less hazardous or non-hazardous by biological degradation or chemical reactions occurring in or on the soil.

(b) Run-on must be diverted away from the active portions of a land treatment facility.

(c) Run-off from active portions of a land treatment facility must be collected.

[Comment: If the collected run-off is a hazardous waste under Part 261 of this Chapter, it must be managed as a hazardous waste in accordance with all applicable requirements of Parts 262, 263, and 265 of this Chapter. If the collected run-off is discharged through a point source to waters of the United States, it is subject to the requirements of Section 402 of the Clean Water Act, as amended.]

(d) The date for compliance with paragraphs (b) and (c) of this Section is 12 months after the effective date of this Part.

2. Issue: Waste Analysis

a. Proposed Regulation and Rationale

The waste analysis requirements in §250.43 of the proposed regulations applied waste analysis to all treatment, storage, and disposal facilities, including land treatment. The waste analysis requirements included: determination of the hazardous constituents and properties of the waste prior to initial disposal; verification of certain properties of each waste shipment received; and periodic, comprehensive analysis of waste if there were indications of changes in composition.

The reasoning behind the proposed recordkeeping requirement is discussed in the background document on waste analysis. In brief, the purpose was to ensure that a facility owner or operator had sufficient current information to manage the waste without endangering human health and the environment.

(b) Comments/Responses to Comments

Comments on the proposed waste analysis requirements are discussed in the background document on waste analysis. As a result of these comments, the Agency has restructured the waste analysis requirements. The final interim status regulations for waste analysis, §265.13, require each owner or operator to develop a waste analysis plan that specifies what analyses are necessary to comply with the regulations. This approach provides significantly more flexibility for the owner/operator. The Agency has also included some minimal waste analysis requirements that are specific to the type of waste management facility.

For land treatment, the Agency considers the waste analyses essential:

- determination of the concentrations of arsenic, barium, cadmium, lead, mercury, selenium, and silver if these substances are present in the waste at levels which exceed the maximum concentrations for characteristics of EP toxicity, contained in Table I of §261.24;

- determination of the concentrations of any substance which caused the waste to be listed as a hazardous waste; and
- determination of the concentrations of arsenic, cadmium, lead, and mercury if food-chain crops are grown.

The first two waste analysis requirements are necessary to determine whether the waste is amenable to disposal in a land treatment facility, i.e., treatable in a soil system and prevents waste constituents from migrating through the soil into ground water. The owner or operator of a land treatment facility must be aware of the presence of hazardous waste constituents in the wastes he manages in order to use appropriate techniques (e.g., modified application rates, pH controls, fertilizing) to properly manage the waste.

The information obtained from waste analysis is also needed to determine appropriate application rates and to develop the unsaturated zone monitoring plan required under §265.278.

The rationale for requiring the owner or operator to determine the concentrations of arsenic, cadmium, lead, and mercury, if food-chain crops are being grown on the site are presented in the discussion on food-chain crops later in this document.

C. Final Regulatory Language

§265.273 Waste Analysis

In addition to the waste analyses required by §265.13, before placing a hazardous waste in or on a land treatment facility, the owner or operator must:

(a) Determine the concentrations in the waste of any substances which exceed the maximum concentrations contained in Table I of §261.24 of this Chapter that cause a waste to exhibit the EP toxicity characteristic;

(b) For any waste listed in Part 261, Subpart D, of this Chapter, determine the concentrations of any substances which caused the waste to be listed as a hazardous waste; and

(c) If food-chain crops are grown, determine the concentrations in the waste of each of the following constituents: arsenic, cadmium, lead, and mercury, *unless* the owner or operator has written, documented data that show that the constituent is not present.

[Comment: Part 261 of this Chapter specifies the substances for which a waste is listed as a hazardous waste. As required by §265.13, the waste analysis plan must include analyses needed to comply with §§265.281 and 265.282. As required by §265.73, the owner or operator must place the results from each waste analysis, or the documented information, in the operating record of the facility.]

3. Issue: Growth of food-chain crops

A. Proposed Regulation and Rationale

The proposed regulations prohibited growing of food-chain crops on the treated area of a land treatment facility. This requirement/prohibition was not included in the proposed interim status standards. However, after further consideration, the Agency has decided that this standard meets the criteria established by the Agency for interim status standards and serves important environmental objectives.

The purpose of the proposed regulations was to protect humans from consuming toxic materials that may contaminate human or animal food grown on land to which hazardous waste has been applied.

Several routes exist by which food-chain crops grown on land treatment facilities may be contaminated by hazardous waste constituents. These are: (1) uptake by plants of the hazardous constituent from the soil, and transfer to the edible portion of the plant, (2) adherence of a waste to crop surface, and (3) ingestion of the waste by grazing animals.

There are many factors which influence the degree to which various hazardous constituents may be transferred along these routes. These include: the chemical, physical, and biological characteristics of the waste; the method of application; the rate of application; season; climate; soil characteristics (including soil type, moisture content, pH, cation exchange capacity of the soil (CEC), hydrous-oxide content, and biological and microbiological activity); the type of crop grown; the method of planting; time and method of harvest, etc.

The information available on the extent to which organic or inorganic substances are actually translocated to crops is limited. Many of the studies which have been done are the subject of a great deal of controversy. For example, many studies failed to include pH effect on metal accumulation, thus the knowledge of pH effect on metal accumulation is insufficient.

Also, there are varying opinions on the validity of extrapolating greenhouse data to represent actual field conditions.

In addition to the difficulties involved with predicting and controlling the various factors which influence the transfer of hazardous constituents to food chain crops, there is only limited information available regarding "safe" levels of various substances in crops. Although the Food and Drug Administration expresses concern about the growing of food chain crops on waste amended soils, no quantitative guidance, except for PCBs*, has been given as to what levels of toxic metals or other hazardous constituents in crops would protect human health.

Also, presentations in the literature on this subject do not always clearly distinguish plant toxicity from animal toxicity. It is recognized that toxic effects to crops can provide some protection for crop consumers (animal and human). However, accumulation of hazardous constituents in crops without signs of plant toxicity creates the opportunity for human exposure to potentially harmful substances. The reported levels of hazardous constituents in crop tissues are sometimes subject of misinterpretation. Care is not always taken to distinguish between data on the edible and nonedible portions of the crop. However, even the "nonedible" portions of the crop may be used for animal feed so that a particular hazardous constituent may still enter the food chain. Also, nonharvested portions of the crop may remain in the soil where the hazardous constituents could contribute to increases in soil levels.

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* Finished animal feeds are the only crops for which FDA has set a PCB tolerance level. This tolerance level is 1.2 ppm in feeds that are given to animals consumed by humans.

While the state of knowledge about translocation of hazardous constituents to crops is incomplete, the Agency does have information to suggest that there is a significant cause for concern that translocation of some of the hazardous constituents to food crops could endanger public health.

The cause of the Agency's concern regarding growth of food-chain crops on land treated with waste is exemplified by a variety of actual incidents, studies, and projections. It should be noted that although many of the incidents described here do not relate specifically to land treatment of hazardous wastes, the concerns they raise are still pertinent to this program. The concerns relate to ingestion by animals, vaporization or direct adherence to crops, and plant uptake.

It is known, for example, that almost any hazardous waste could be translocated through direct ingestion by grazing animals. Soil is ingested by grazing animals along with herbage from the adhering to leaves, from soil on roots, and from earthworm casts. In the case of a land treatment site, the soil is likely to be a mixture of soil and waste. Factors influencing soil/waste ingestion include the type of animal, the type of soil and type of forage, stock density and other management variables, rainfall, and earthworm populations.[15,16]

Grazing animals have been estimated to ingest soil in amounts ranging from 2 to 14 percent of the diet.[17] Healy has shown that soil can make up as much as 8 percent of the dry matter intake of grazing cattle.[18] Furthermore, cattle have been observed grazing on land used for the application of industrial sludges.[19]

In 1976, in Bloomington, Indiana, municipal sludge laden with PCBs was applied to pasture land which was grazed by a single dairy cow. The PCB levels of the sludge ranged from 240 to 1,700 ppm and soil levels in the pasture reached 200 ppm PCBs.[20] As a result of grazing in this pasture, the cow's milk contained 5 ppm PCBs (fat basis), and was thus not fit for human consumption. (The FDA tolerance for unavoidable PCBs in milk shipped interstate commerce is 1.5 ppm.)

Other instances of the transfer of toxic organic compounds from pasture soil to grazing animals have been reported. In Gossimer, Louisiana, hexachlorobenzene was accidentally spilled onto pasture land, resulting in the impoundment of 20,000 cattle, until levels of the contaminant in these animals were reduced.[21] In Maryland, heptachlor used for the control of weevils in alfalfa was later found to have contaminated the milk of grazing animals.[22] Harrison et al., have shown that soil containing DDT residues can supply considerable amounts of total DDT to ewes and that these residues can be transferred to lambs.[23]

Some organic wastes may vaporize and redeposit on the tissue of plants. While few studies have been done in this area, information has been developed which shows that lipophilic (oil) crops like soybeans tend to take up lipophilic hyrdrocarbons like chlorinated hydrocarbon insecticides. Also, the surface of the leafy plants can become contaminated with small amounts of these materials, resulting primarily from their vaporization from the soil and redeposit on the plants. The risks of the contamination in this instance is under study.[24]

The adherence of toxic substances to crops is another avenue for transfer. The likelihood of surface contamination occurring is greatest when liquid waste are applied to crops. An example of surface contamination is a case where DDT was once applied routinely to sweet corn in large amounts to control the corn ear worm. It has since appeared on the surface of carrots grown in the same fields, and has made those carrots unsuitable for sale.[21]

Nearly all of the published work on adherence of land-applied wastes to growing crops is based on application of municipal sludge. However, Batey, et al., found high levels of copper and zinc in or on crops sprayed with swine manure slurries.[25] Boswell found high levels of cadmium, lead, and chromium on foliage following application of municipal sludge filter cake.[25] Chaney and Lloyd have shown that municipal sludge applied to pasture grass can, shortly after application, result in the adhered sludge making up 30 percent of the dry weight of the crop.[26] Rainfall and weathering over an 80-day period did not remove much of the sludge from the grass. However, the 80 days of growth permitted a dilution of the weight of the sludge to the weight of the crop. Still, at the end of the 80-day period, 5 percent of the dry weight of the grass was actually found to be adhered sludge. This study was performed in the rainy east, and therefore, one would expect that sludge application to grasses in more arid regions would result in even greater adherence of the sludge to the crops. A greenhouse study by Jones et al., using simulated rainfall, resulted in similar conclusions to those of Chaney and Lloyd.[27] Once the sludge had dried on the grass, rainfall was not effective in reducing the amount of adhered sludge. Rainfall was found only to be effective if it occurred immediately after sludge was applied.

Heavy metals, such as cadmium, molybdenum, selenium, mercury, and lead, can be absorbed by crops from the soil of land treatment facilities. The uptake of mercury and lead by most crops, however, is not nearly of the magnitude of these other metals.

Cadmium may be taken up by plants even though only very low levels exist in the soil. The transfer of cadmium from the soil to plants is well documented in the background document supporting EPA's recently promulgated Criteria for Classification of Solid Waste Disposal Facilities and Practices. Crops such as leafy vegetables or root crops take up significantly greater amounts of cadmium than do grains or grasses.

Maintaining a near-neutral pH on a land treatment facility to control plant uptake of most heavy metals can lead to an increase in the uptake of molybdenum and selenium. These two metals are more soluble at neutral and basic pH's. Molybdenum's toxicity has been a serious problem in livestock food production in certain areas of the western United States. Forages grown on naturally wet, alkaline, or neutral soils can contain toxic concentrations of molybdenum.[28] Certainly, the land application of wastes high in molybdenum to such soils would aggravate this naturally-occurring problem.

In Oregon, a study using shredded municipal waste at an application rate of 900 metric tons per hectare resulted in a significant uptake of molybdenum by alfalfa. The levels reached would have been potentially hazardous to likestock if only one feed source was used.[29]

Land treated wastes do not generally increase levels of mercury in plants. However, Van Loon found very considerable levels of mercury in tomatoes where municipal sludges (the highest containing 25 ppm mercury) were used.[27,32] Results of Yugoslav studies showed that mercury levels of most plants were low (1 to 50 ppb) compared to the mercury content of soils in which they grew (100 to 600 ppm). Carrots, grasses, and some weeds had more mercury (800 ppb) than other plants. Jackson found that mercury in the tops of barley and soybean plants whose roots were in a mercury solution came from mercury vapor released from the roots, rather than from translocation. If mercury volatilizes from waste-treated soils, plants could absorb it.[30]

Significant increases in the lead content of some crops as a result of soil application of lead have been reported, particularly in soils deficient in phosphate. Because of the buffering capabilities of soils and plant roots, as well as absorption and precipitation phenomena, most lead in soils is not likely to be translocated to the above-ground portions of plants. However, uptake to the above-ground portions can be appreciable following changes in the environmental and physiological condition of the plant.[33] In fact, investigations of existing land treatment sites have indicated that significant increases can occur in the lead content of crops, such as clover and various grasses.[30]

In general, a minimal amount of toxic organic compounds are absorbed by plant roots and transferred to other parts of the plant. Organics with large molecules, such as pesticides and PCBs, do not tend to pass the semipermeable membrane of plant roots. Consequently, plants posses the ability to exclude large organic molecules added to soils, which result in minimal impact on the quality of forage and grains.[32] An exception is organochlorine pesticides which are absorbed by plant roots and transferred to other parts of the plant, but at a very low rate compared to the concentration in the soil.[33]

The absorption of PCBs by plant roots and translocation within plants is considered minimal, but some studies have reported what appeared to be low levels of plant uptake as a result of heavy application rates.[34] These studies further suggest, however, that PCBs are not actually taken up by the plant but, rather, are physically adsorbed on the surface of the roots.[32]

The examples do suggest that there are known cases where translocation of toxic substances to crops has occurred, and that there is a significant potential for contamination of crops from soils treated with hazardous wastes to crops grown on that soil.

Although not legally required, the Agency also examined the benefits to be gained from growing food-chain crops in treated soils. The Agency believes that such benefits are minimal. Certainly the very small amount of land so used is not needed for good growth from a national perspective. It represents a negligible portion of the total productive land for crop growth available in this country. Furthermore, there are other productive uses of such land, for example, crop farming of non-food-chain crops, if crop growth is desired. The Agency recognizes that growth of food-chain crops can result in a source of revenues to help defray disposal costs. However, the Agency does not believe that such revenues minus the cost of growing and marketing the crops, especially in light of the cost of waste and crop monitoring and other controls needed to ensure protection of public health, are significant to the economic viability of land treatment.

The Agency considered the alternative of specifying safe application rates of various wastes to the soil for growth of food crops. The Agency also considered establishing safe levels of various substances in plants and requiring crop monitoring to control potential hazards. As the above discussion points out, the data and information base available for such an approach does not exist.

In view of all of the above considerations, the Agency concluded that it should ban the growth of food-chain crops on hazardous waste land treatment facilities.

B. Comments on the Proposed Regulation

- The term "food-chain crops" means tobacco; crops grown for human consumption; or crops grown for pasture, forage, or feed grain for animals whose products are consumed by humans.

- The regulation is too restrictive. If studies of plant tissue residues and crop uptake demonstate that the crop will not take up the hazardous constituents, growth should be permitted.

- The restriction will abolish the practice of growing food chain crops at land treatment facilities. EPA should require tests to determine if crops grown on such land are suitable for consumption by humans or livestock

- Growth of food-chain crops should be permitted if, after study over two growing seasons, the consumable part of the crop can be shown to be non-toxic.

- The regulation is too restrictive. It should be replaced with a requirement for monitoring of crop uptake of hazardous constituents.

- The regulation is too restrictive. The regulations should take into consideration the hazardous characteristics of the waste, the nature of the soil, and the substance being taken up by crops. Growth should be allowed.

- The regulation should be based on application rates of waste, rather than a prohibition. EPA should develop regulations controlling application and specifying testing requirements.

- The issue is blown out of proportion. Many hazardous wastes are phytotoxic, which makes growth of any crop impossible. However, other wastes are amenable to land treatment on crop land.

- Growth of food-chain crops should not be prohibited without qualification. Certain crops and grasses have assimilative capacity for a variety of potential hazardous waste, e.g., bermuda grasses. Without their use, land treatment facilities would have to be bigger.

- The prohibition is inconsistent with EPA's position on POTW sludge. Textile sludges present no greater toxic potential than POTW sludges.

- Studies have shown that land treatment of utility ash and sludge do not result in unsafe levels of potentially hazardous contaminants in crops. Gypsum and fly ash are used routinely to correct soil deficiencies. An exception should be provided where reasonable evidence and studies show that there is no substantial hazard to human health.

- The regulation would prohibit using waste lime as a soil conditioner on crop lands. Waste limes from the sugar beet refining process or from lime kilns have high levels of $CaCO3$ (85 percent) and $MgCO3$ (5 percent), which neutralize acid soils. Waste lime from beet processing has been in use for 25 years.

- Crude oil does not have as high a concentration of heavy metals as other waste oils. It has been demonstrated that waste crude oil adds nutrient value and that it is perfectly safe to grow crops on land so treated.

- The regulation would eliminate land treatment of waste for beneficial uses, i.e., as agricultural fertilizers. It would raise disposal costs by 700 percent. Thus, there is a poor risk and benefit ratio for a ban.
- The prohibition is totally appropriate, since there is very little information on toxics and persistent organics beyond the work on metals in POTW sludges. Until data are developed on crop uptake of these other toxins, land contaminated with them should not be used for agricultural purposes.

C. Response to the Comments

1. Food chain crops should be defined.

A definition for "food chain crops" was provided in the proposed rules on page 58997, Section 250.41(b)(33). The same definition is included in the final interim status regulations. The definition reads: "Food chain crops" means: tobacco; crops grown for human consumption; or crops grown for pasture, forage, or feed grain for animals whose products are consumed by humans." This definition does not preclude the growing of a crop which is normally consumed by humans or animals if the crop is only grown as a ground cover and then plowed under.

2. Monitor crop uptake.

The option of analyzing a crop for uptake of hazardous constituents is conceptually attractive, but presents certain problems in practice. The most basic problem is that the Food and Drug Administration has not established crop tolerance levels for most of the hazardous constituents of concern; hence, there is no standard of comparison.

However, the Agency does believe that crop monitoring represents an acceptable general approach when comparing hazardous constituents in the crops to background levels. Comparing crops grown on land treatment facilities with crops grown in nontreated soils is the only feasible way of applying crop monitoring in most situations, due to lack of defined tolerance levels. The revised regulatory language permits an owner or operator to present such data to the Agency as a part of the support for a claim that growth of a crop on a land treatment facility presents no danger to public health.

3. Prescribe acceptable application rates. Base the standard on the characteristics of the waste, the soil, and the crop being grown. Many wastes are amenable to land treatment on cropland.

This approach, perhaps coupled with crop monitoring, would be an ideal approach if the state-of-the-art would support it.

Unfortunately, this is not the case. Except for cadmium, information on acceptable application rates is not available for combinations of soil, hazardous wastes, and crops. Consequently, this approach is not feasible as a general approach at this time. Such an approach is used for cadmium, however, because there is sufficient data to support it. However, the Agency believes that it is important to begin to develop this information through monitoring of conditions in a land treatment facility. Furthermore, the Agency believes that an owner or operator should have the opportunity to demonstrate to the Agency that it has developed such information for a particular situation. This concept is embodied in the interim status standards.

4. Certain crops and grasses have assimilative capacity for potentially hazardous substances, e.g., bermuda grasses. The regulation should be qualified to allow their growth.

The proposed regulation is not without qualification in that only food chain crops are restricted. Crops which are not used for human consumption or consumed by animals whose products are not consumed by humans are not restricted. Therefore, a crops such as burmuda grass can be grown at a land treatment site for the purpose of assimilating waste components or providing ground cover. In this case, the grass could not be used as an animal feed for animals whose products are consumed by humans. Because a food chain crop is defined by its end use, crops which may normally be considered food chain crops can be grown on the landfarm if adequate measures are taken to prevent its consumption by humans or animals whose products are consumed by humans.

5. The prohibition is inconsistent with Subtitle D regulations. Textile sludges present no greater hazard to crop growth than wastewater treatment sludge.

The Agency agrees that the approaches are currently different. However, the cadmium standards established in the Criteria have been incorporated into the interim status standards in order to have consistency between those two regulations. The requirements concerning PCB in the Criteria were not included at this time. This issue will be resolved as part of the consideration between the RCRA programs and the Agency program for handling PCB under the Toxic Substance Control Act. Also, the interim status standards will provide an owner or operator the opportunity to present data showing that crop growth on such waste is safe.

6. Utility ash and sludge is beneficial to some solids; presents no hazard to crops.

The interim status standards will allow an owner or operator to grow food chain crops at a land treatment facility, provided he has data indicating that such a practice does not pose a threat to public health. Therefore, an owner or operator at a land treatment facility receiving utility ash and/or sludge may grow food chain crops provided he can document that such crops are safe.

7. The regulation would prohibit using waste lime as a soil conditioner on crop lands.

The Agency acknowledges the point raised by this comment and has exempted waste lime from this prohibition if it is only clasified as a hazardous waste due to its high pH. This provision is specified in Part 261.

8. Crude oil adds nutrient value to the soil, and crop growth on land so treated is safe.

As with all waste which is classified hazardous, the interim status standards will allow an owner or operator to grow food chain crops at a landtreatment facility provided he has data indicating that such a practice does not pose a threat to public health.

9. The prohibition wold eliminate land application of hazardous waste for use as agricultural fertilizers and raise disposal costs by 700 percent.

No data to support the claim of a 700 percent cost increase were provided, and the Agency disagrees strongly with this estimate. Since the prohibition only applies to the growing of crops for human consumption or for consumption by animals whose products are consumed by humans, the Agency does not believe that this restriction will result in a major impact on the landfarming of hazardous wastes. Because food chain crops often have a higher market value than non-food-chain crops, there may be some reduction of income from landfarms. However, because many non-food-chain crops are often grown on less productive lands, the agricultural fertilizer value of the hazardous wastes may be better utilized by these crops. Thus, the Agency sees no clear or significant benefit from growing food chain crops.

10. Summary

The Agency proposed a ban on the growth of food-chain crops at hazardous waste land treatment facilities. After reviewing comments, EPA decided that during the interim Status period, food-chain crops may be grown, provided that certain requirements are met. The Agency's decision not to continue with the ban during the interim status period is based on the following reasons: First, there exist insufficient data to indicate that the growth of food-chain crops at a hazardous waste land treatment facility would always create a risk to those who consume such crops. Second, banning the growth of food-chain crops would be inconsistent with the regulatory approach taken to protect food-chain crops under Subtitle D of RCRA. These regulations were finalized as the Criteria for Clasification of Solid Waste Disposal Facilities and Practices (40 CFR 257) on September 13, 1979.

The Agency believes it would be unjustified to impose a ban on the growth of food-chain crops at land treatment facilities if there were convincing evidence that the crops can be grown without posing a significant public health risk. It is conceivable that a substance in a hazardous waste may not be taken up by certain food-chain crops, or after a period of treatment, the substance may degreade into products non-hazardous to humans.

For example, some wastes may be used to control pH of the soil, and there may be a significant body of data which supports that such a use does not pose a public health risk. The Agncy does not wish to prohibit such uses of waste, realizing that the waste may simply be replaced with commercial product containing the same chemical constituents as the waste.

The cadmium standards detailed in the Criteria do not set limits for food-chain crops, but instead prescribe annual application rates and limits on cumulative loading based on the specific health risk posed by cadmium. As a result, a waste, regardless of the cadmium concentration, may be applied to land on which food-chain crops are grown. Compliance with the Criteria can be achieved merely by applying less waste. The Agency believes it would be unjustified in banning the growth of food-chain crops at facilities receiving waste that is hazardous due to cadmium, since such a waste can be applied in a manner that would not violate the standards prescribed in the Criteria.

The Agency, while not considering a ban appropriate because of the reasons mentioned, had to deal with the task of how to structure the regulations to permit the growth of food-chain crops, and at the same time be assured that public health would be protected. In order to achieve this, the Agency devised a two-part test to determine whether food-chain crop growth on land treatment facilities is acceptable. The two-part test requires the owner or operator, prior to growing a crop, to demonstrate that the hazardous waste constituents in the waste, as well as arsenic, lead and mercury will not (1) be transferred to the edible portion of the crop by plant uptake, by direct contact or by transfer to food-chain animals; or (2) occur in greater concentrations in the crop than in crops grown on control soils under similar circumstances in the region.

In order to demonstrate comparability, an owner or operator must use actual field studies. A test plot would be considered an acceptable field study. Also, the conditions under which the comparable crops are grown must be similar to the conditions found at the facility. For example, soil type, soil moisture, soil pH, soil nutrients, photo period and length of growing season, must be similar at both facility and control sites. The owner or operator must also document the sample selection criteria, sample size determination, analytical methods and statistical procedures used to make the demonstration. In order to determine the compliance prior to waste application, the owner or operator must pre-test samples of the crop using the type of waste and application rate that will be used at the facility. The sample must be that portion of a crop which would be consumed, e.g., corn kernel, wheat grain etc.

The two-part test approach is based on the premises that since the Agency does not have a clear specification of the "no risk" level of such contaminants in food crops, it is reasonable to assume that the level of such contaminants presently in food crops is acceptable. However, future research data may indicate that health tolerances in food crops should be higher or lower than the average levels otherwise present in such crops.

Arsenic, lead, and mercury were specifically identified because of their relatively high toxicity to humans and evidence that they can be taken up by crops (38). Mercury can enter plants through the roots and be readily translocated throughout the plant. Arsenic tends to accumulate in the roots of most crops, which is a concern when root crops such as radishes, carrots, etc., are grown. When in high concentrations in the soil, lead has been shown to translocate to crops.

The Agency is concerned that there are other hazadous substances in the wastes, e.g., toxic organics, that may be taken up by crops.

The difficulty in identifying toxic organics is due to the lack of data in this area. Most crop studies have addressed only inorganics: thus there is a paucity of data on the uptake of toxic organics by crops. However, the Agency will identify other hazardous substances of concern as information becomes available.

In order to be consistent with the Criteria for the Classification of Solid Waste Disposal Facilities and Practices, the standard developed in those regulations for cadmium has been incorporated into the interim status regulation. Thus the cadmium standard present in the Criteria will be applicable to hazardous waste land treatment facilities.

The Criteria include two approaches for the land application of wastes containing cadmium. The first approach incorporates four site management controls; control of the pH of the waste and soil mixture; annual cadmium application limits that are reduced over time; cumulative cadmium application limits based on soil cation exchange capacity (CEC); and restriction of the cadmium concentration in waste applied to facilities where tobacco, leafy vegetables and root crops are grown.

The second approach allows unlimited application of cadmium provided that four specific control measures are taken: first, the crop grown can only be used as animal feed. Second, the pH of the soil must be maintained at 6.5 or above for as long as food-chain crops are grown. Third, a facility operating plan must describe how the animal feed will be distributed to prevent human ingestion: Fourth, future owners are provided notice (through provisions in land records of property deed) that there are high levels of cadmium in the soil and that food-chain crops should not be grown.

The Agency has added a provision to the interim status regulations that requires owners or operators of land treatment facilities on which food-chain crops have been grown, or are going grown, to notify the Regional Administrator within sixty (60) days after the effective date of the regulations if they intend to grow food-chain crops in the future. In addition a note in the regulation apprises an owner or operator, who for the first time grows food-chain crops after the effective date of the regulation, that he has made a change in process and must notify the Administrator under Section 122.23(c)(3) of the consolidated permitting regulations. These notification procedures are designed to give the Regional Administrator notice of those facilities that are engaging in the environmnentally sensitive activity of applying hazardous waste to food-chain crops. This information will assist the Regional Admnistrator in the establishment of priorities for permitting.

It is the Agency's firm belief that growth of food-chain crops on land contaminated with hazardous waste is an issue which should be dealt with cautiously, and should be practiced only where there is convincing evidence that it poses no threat to public health. In the opinion of the Agency there is little need to grow food-chain crops at land treatment facilities. The small amount of land use for land treatment represents a negligible portion of the total productive land available for crop growth in the Unitd States. Furthermore, there are other productive uses of the land, such as ornamental horticulture, growth of fiber crops or other non-food crops.

The Agency recognizes that growth of food-chain crops can result in a source of revenue to help defray disposal cost. However, the Agency does not believe that such revenues, minus the cost of growing and marketing the crops, are significant to the economic viability of landtreatment, especially in light of the cost of monitoring wastes and crops and other controls needed to ensure the protection of public health.

D. Final Regulatory Language

§265.276 Food-chain crops

(a) An owner or operator of a hazardous waste land treatment facility on which food-chain crops are being grown, or have been grown and will be grown in the future, must notify the Regional Administrator within 60 days after the effective date of this Part. [Comment: The growth of food chain crops at a facility which has never before been used for this purpose is a significant change in process under §122.23(c)(3) of this Chapter. Owners or operators of such land treatment facilities who propose to grow food chain crops after the effective date of this Part must comply with §122.23(c)(3) of this Chapter.]

(b)(1) Food chain crops must not be grown on the treated area of a hazardous waste land treatment facility unless the owner or operator can demonstrate, based on field testing, that any arsenic, lead, mercury, or other constituents identified under §265.273(b):

(i) Will not be transferred to the food portion of the crop by plant uptake or direct contact, and will not otherwise be ingested by food chain animals (e.g., by grazing): or

(ii) Will not occur in greater concentrations in the crops grown on the land treatment facility than in the same crops grown on untreated soils under similar conditions in the same region.

(2) The information necessary to make the demonstration required by paragraph (b)(1) of this Section must be kept at the facility and must, at a minimum:

(i) Be based on tests for the specific waste and application rates being used at the facility; and

(ii) Include descriptions of crop and soil characteristics, sample selection criteria, sample size determination, analytical methods, and statistical procedures.

(c) Food chain crops must not be grown on a land treatment facility receiving waste that contains cadmium unless all requirements of paragraph (c)(1)(i) through (iii) of this Section or all requirements of paragraph (c)(2)(i) through (iv) of this Section are met.

(1) (i) The pH of the waste and soil mixture is 6.5 or greater at the time of each waste application, except for waste containing cadmium at concentrations of 2 mg/kg (dry weight) or less;

(ii) The annual application of cadmium from waste does not exceed 0.5 kilograms per hectare (kg/ha) on land used for production of tobacco, leafy vegetables, or root crops grown for human consumption. For other food chain crops, the annual cadmium application rate does not exceed:

Time Period	Annual Cd Application Rate (kg/ha)
Present to June 30, 1984	2.0
July 1, 1984 to Dec. 31, 1986	1.25
Beginning Jan. 1, 1987	0.5

(iii) The cumulative application of cadmium from waste does not exceed the levels in either paragraph (c)(1)(iii)(A) of this Section or paragraph (c)(1)(iii)(B) of this Section.

Soil cation exchange capacity (meq/100g)	Maximum cumulative application (kg/ha)	
	Background soil pH less than 6.5	Background soil pH greater than 6.5
less than 5	5	5
5-15	5	10
greater than 15	5	20

(B) For soils with a background pH of less than 6.5, the cumulative cadmium application rate does not exceed the levels below: Provided, that the pH of the waste and soil mixture is adjusted to and maintained at 6.5 or greater whenever food chain crops are grown.

Soil cation exchange capacity (meq/100g)	Maximum cumulative application (kg/ha)
less than 5	5
5-15	10
greater than 15	20

(2) (i) The only food chain crop produced is animal feed.

(ii) The pH of the waste and soil mixture is 6.5 or greater at the time of waste application or at the time the crop is planted, whichever occurs later, and this pH level is maintained whenever food chain crops are grown.

(iii) There is a facility operating plan which demonstrates how the animal feed will be distributed to preclude ingestion by

(iii) The cumulative application of cadmium from waste does not exceed the levels in either paragraph (c)(1)(iii)(A) of this Section or paragraph (c)(1)(iii)(B) of this Section.

Soil cation exchange capacity (meq/100g)	Maximum cumulative application (kg/ha)	
	Background soil pH less than 6.5	Background soil pH greater than 6.5
less than 5 ------------------	5	5
5-15 --------------------------	5	10
greater than 15----------------	5	20

(B) For soils with a background pH of less than 6.5, the cumulative cadmium application rate does not exceed the levels below: Provided, that the pH of the waste and soil mixture is adjusted to and maintained at 6.5 or greater whenever food chain crops are grown.

Soil cation exchange capacity (meq/100g)	Maximum cumulative application (kg/ha)
less than 5 --------------------------	5
5-15-----------------------------------	10
greater than 15------------------------	20

(2) (i) The only food chain crop produced is animal feed.

(ii) The pH of the waste and soil mixture is 6.5 or greater at the time of waste application or at the time the crop is planted, whichever occurs later, and this pH level is maintained whenever food chain crops are grown.

(iii) There is a facility operating plan which demonstrates how the animal feed will be distributed to preclude ingestion by humans. The facility operating plan describes the measures to be taken to safeguard against possible health hazards from cadmium entering the food chain, which may result from alternative land use.

(iv) Future property owners are notified by a stipulation in the land record or property deed which states that the property has received waste at high cadmium application rates and that food chain crops should not be grown, due to a possible health hazard. [Comment: As required by §265.73, if an owner or operator grows food chain crops on his land treatment facility, he must place the information developed in this Section in the operating record of the facility.]

4. Issue: Soil monitoring

a. Proposed Regulation and Rationale

The proposed interim status regulations required soil monitoring only as it related to closure. Those requirements will be discussed in the section of this document dealing with closure. The other soil monitoring requirements of the proposed regulations were not included in the proposed interim status standards. However, after further consideration, the Agency has determined that soil monitoring serves an important environmental objective and meets the criteria established by the Agency for interim status standards. Soil monitoring is necessary during interim status because it is an indicator of how well the land treatment process is working.

The proposed soil monitoring requirements included:

- Determine background soil conditions by taking one soil core per acre in the area to be treated at a depth of three times the depth of the zone of incorporation, or 30 centimeters, whichever is greater. The bottom one-third of the soil core must be analyzed for the hazardous constituents in the waste.

At new facilities, the cores must be taken prior to beginning operation. At existing facilities, the cores must be taken within six months of the effective date of the regulations.

- Soil conditions in the treated area of a landfarm must be determined by taking one soil core per acre semiannually at three times the depth of the zone of incorporation, or 30 centimeters, which is greater. The bottom one-third of the core must be analyzed for the hazardous constituents in the waste.
- If soil monitoring shows that the concentration of a hazardous constituents significantly exceeds background levels, the owner/operator must: (1) notify the Regional Administrator within seven days, (2) determine the areal extent of vertical contaminant migration, and (3) discontinue all land treatment in the contaminated area until corrective measures are taken.

There were three basic elements to this proposed procedure, each with a separate rationale. These elements were the sampling procedure (i.e., number of samples), the depth of the core samples, and the corrective action required. The sampling procedure was based largly on subjective reasoning of how many samples would be required to obtain an adequate representation of the soil in the landfarm. The requirement was not based on a statistical test.

The corrective actions specified were based on the assumption that migration of contaminants to a depth of three times the depth of the zone of incorporation constituted a potential threat to public health and the environment, and that no further land treatment should occur until this situation was corrected, as determined by the Regional Administrator.

Perhaps the most significant element of the requirement was the selected depth of three times the depth of the zone of incorporation as the "performance standard" for the facility. This standard was based on a number of technical studies which suggested that in a properly designed and operated land treatment facility, there should be little or no migration of contaminant beyond the zone of incorporation.

The Agency has identified a considerable amount of literature and empirical data indicating limited waste migration at hazardous waste land treatment facilities.

A literature review by Page[6] in 1974, evaluated the potential hazards of the application over 10 years of sewage treatment plant wastes to agricultural soils. Page found that in most soils, the percentage of heavy metals (Ag, Ba, Cd, Co, Cr, Cu, Hg, Mn, Ni, Pb, Sn, and Zn), applied in the form of sludge which move beyond the depth of tillage, is quite small. This same phenomenon has been observed in field studies where oily hazardous waste has been land treated. Meyers and Huddleston[3] applied oil refinery waste (API Separator Sludge, tank bottoms, slop oil) at three different application rates over a period of three years. The study indicated no significant leaching or migration of organic or inorganic waste constituents. Similar findings were reported by Kincannon[7] in his review of an 18-month field study conducted in 1971. Three types of oil feed materials were selected to represent different combinations of hydrocarbon types. The oil types included oil tank bottoms, buncker C fuel oil, and waxy oil. Neither oil nor nutrients (added as fertilizer) migrated vertically during the study.

A recent state-of-the-art study[2] on land treatment of municipal and industrial wastes found no incidents of water pollution at any of the six sites studied. Soil sampling at these sites suggested that heavy metals and trace elements appear to be retained in the zone of incorporation.

The middle section (middle one-third of core) is the buffer zone. Even though data indicate that the extent of migration of waste contaminants is generally limited to the zone of incorporation, a buffer zone was provided to allow for the effects of variability within a site, (e.g., the depth of the zone of incorporation may vary from six to eight inches).

The lower section (bottom one-third of core) represents the indicator zone. The presence or absence of waste contaminants in this zone would indicate whether or not a land treatment facility is functining properly.

An approach similar to that proposed by EPA was arrived at independently by an EPA contractor that recently performed a state-of-the-art study on land treatment practices.[2] The report stated that "a landfarm site must be properly monitored to ensure that waste constituents are retained in the layer of incorporation. This can be accomplished by collecting soil samples at three depths (0 to 30 cm, 30 to 60 cm, and 60 to 90 cm) prior to site activation, and at 3 to 6-month intervals thereafter. Soil samples collected should be analyzed for those constituents present in the waste which may result in water pollution problems." The only major difference between this and the EPA approach is the contractor's recommendation of a fixed core sample depth. The Agency considered the variable depth related to the depth of tillage to be more flexible in accommodating the different tillage methods that currently exist among sites.

b. Comments on the Proposed Regulations

1. Soil Monitoring vs. Ground-water Monitoring

- Neches' land treatment research supports EPA's conclusions that soil monitoring will detect any migration long before ground-water monitoring could detect it.

- Ground-water monitoring at land treatment facilities is unnecessary, especially with the proposed siting and surface controls outlined in §250.45-5(b) and (c).

- Because our own data has shown little migration, we strongly support soil monitoring in lieu of ground-water monitoring. If, at some later time, soil monitoring indicates significant migration, ground-water monitoring could be commenced.

- Because the published literature clearly shows little migration, we strongly support soil monitoring lieu of ground-water monitoring.

- The proposed soil monitoring program is not adequate to protect ground water resources. Some potential ground-water contaminants migrate slowly through soils; however, there are many potential contaminants that can migrate very quickly through soils, depending on soil conditions and waste characteristics. Situations could exist where potential ground-water contaminants would migrate to ground water and not be detected by semiannual soil monitoring.

- EPA could not identify a single incident of ground-water contamination resulting from land treatment of hazardous wastes, which would indicate that the soil monitoring requirements are overly restrictive and should be replaced by test wells at the property line. Soil monitoring should be performed, but for day-to-day operations, not for compliance monitoring.

2. Soil Monitoring

A. Sampling Procedure (Number of Samples; Extent of Analysis)

- Analyzing for all hazardous components is unreasonable and expensive. Should analyze only "as necessary" to detect vertical migration of wastes. It is beyond present day knowledge to analyze for all hazardous constituents since:

  - many wastes are very complex and variable in composition

  - quantitative analysis may not show biological activity or chemical form of some components.

- very few labs have the expertise or equipment to do quantitative analysis of soil samples, and there are few standardized analysis procedures

Because of the above, should analyze for indicators of tracers, such as bromide.

- Should analyze for degradation products rather than wastes, as applied. Should change the regulation to "analysis as necessary to detect vertical migration of hazardous constituents."

- Accumulation of waste constituents in the soil should be compared with "acceptable" levels of those constituents rather than with background.

- The number of samples and extent of analysis is excessive for low hazard wastes, and would be expensive ($200-$400 per sample). Should analyze only for major species unless migration is detected. For example, large treatment areas with uniform terrain and cover crop would hardly require so many samples and would result in redundant data. Analyzing for all constituents which make the waste hazardous is overkill, also. (Comment listed 28 substances which potentially would have to be monitored for fly ash and scrubber sludge.) Should analyze for major species initially, such as Ca, Na, SO_4, etc. If migration is indicated, then more extensive trace analysis could be done.

- No methods were provided for obtaining core samples, and there is an absence of analysis methods and methodology for determining background condition. Should require a minimum of 10 background samples and not less than one per acre.

- Soil monitoring and comparison to background analyses is too vaguely described. Suggest that a periodic report of analyses be required and that the definition of "significantly exceeded background levels" be more scientifically specified.

- Should define significant increase over background. Suggest defining significant increase in terms of number of samples, i.e.:

No. of Samples	Significant Increase over Background
1	1.2
2	1.4
3	1.6
4	1.8

- One sample per acre is arbitrary and unreasonable. Soil samples are time-consuming and expensive, and should be minimized. Five samples are sufficient--one on each corner and one in the center of the facility, for plots of 50 acres or less.

- For background purposes, one core per acre is excessive and expensive. Should sample the four corners and middle of the treated area. If these samples show inconsistencies, then additional samples could be taken.

- The cost of sampling large land treatment areas will be exorbitant and for no good reason. Uniformity of the soils in the tract can be determined by sampling of the four corners and middle of the site.

- Should allow a variance for the owner or operator to show that his sample will give representative results.

- Far fewer than one soil core per acre would accomplish adequte testing at three times the depth of the zone of incorporation. Testing of each acre, if necessary, should be confined to the actual zone of incorporation.

- Background and treated soil conditions can be determined without requiring one core per acre. A more rational and reasonable requirement would be one soil core per 10 acres, but not less than one core per treated area.

- The total number of soil core samples to be analyzed annually is excessive and should be reduced by either taking fewer samples per total acreage as acreage increases, or lengthening the sampling frequency froms semiannual to annual. Suggest the following to give adequate quantities of soil core samples to be analyzed:

    - one core per acre for 5 acres or less

    - one core per 1.5 acres for 6 to 9 acres

    - one core per 2 acres for 10 to 30 acres

    - one core per 4 acres for greater than 60 acres

- One soil core per acre represents considerable redundancy. Samples should be taken to represent specific areas receiving specific wastes at particular application rates. An area receiving a specific waste mix at a uniform application rate throughout the area should be treated as a single unit for soil sampling and analysis.

- Testing of a subsample of composited samples from several different locations in an area receiving a particular waste at a particular application rate should be allowed.

⑬

B. Sampling at Three Times the Depth of the Zone of Incorporation

- Limiting migration to three times the depth of the zone of incorporation is arbitrary and unreasonable. Application to the surface should not be more limited in penetration limits than deeper application. Migration limits should be based on case-by-case conditions and should allow the owner/operator to demonstrate that no ground water threat exists.

- Limiting migration to three times the depth of the zone of incorporation is not acceptable. Should allow migration to a depth safely above the shallowest usable ground water. Some land treatment faciities may be underlain by a hundred feet of non-water-bearing soil capable of absorbing contaminants.

- Application of wastes with high solids content will raise the surface of the land treatment facility gradually, eventually causing problems with the definition of the zone of incorporation. Suggest that core depths be determined from the initial depth and location of the zone of incorporation.

- A fixed core depth, such as three feet, should be established from the initial level of the zone of incorporation. The reason is to take advantage of the assimilative capacity of the soil to arrest transport of contaminants, yet provide a reasonable depth for monitoring to assure that the transport is not excessive. These requirements have nothing to do with the depth to which the soil was plowed, so should not be tied to that depth. This overcomes the problem of defining a (sample) depth when waste is not plowed at all.

- Surface soils should be sampled as protection for the land treatment facility operator, since soil composition can change dramatically with depth and composition of surface soils are subject to change due to various manmade activities and emissions.

- The soil monitoring requirements should be broadened to include anaerobic operations. Aerobic and anaerobic operations do not occur in the same locations in the soil profile and final monitoring should not be done until after the last operation in the sequence. An example is denitrification. A high nitrogen waste would yield nitrate in the aerobic zone within 12 inches of the zone of incorporation. Further down, the nitrate will denitrify (convert to nitrogen gas) under proper conditions. Soil monitoring locations do not relate to the zone of incorporation in this case.

- The limitation on significant increase of hazardous contaminants below the zone of incorporation is in conflict with the planned dilution of certain inorganic ions in the ground water, i.e., chloride. A waste may be hazardous because of its concentrations of chloride or sulfate. It is well recognized that the chloride does not degrade and will eventually dilute in the ground water. This should be recognized in the regulations.

- We agree with the depth of three times the depth of the zone of incorporation, or 30 centimeters, whichever is greater, for taking soil samples.

c. Corrective Action

- Requiring land treatment facilities to cease operations and perform corrective actions upon detecting an increase above background may force land treatment facilities to close when no threat to underground drinking water supplies or human health exists. Instead of requiring that operations be discontinued, EPA should require that the magnitude of the threat to area ground water be determined and that, based on this analysis, the Regional Administrator may order the land treatment facility to be closed and/or corrective action taken. Requiring the owner/operator to cease operations and take corrective action is justified if human health and the environment are endangered. However, a significant increase over background does not necessarily constitute a threat. Soil monitoring should be used to indicate when further investigation is warranted to determine if corrective action is necessary.

- This comparison with background and corrective action restricts the mechanism by which land treatment functions. Concentrations of constituents added to a landfarm will certainly increase in the zone of incorporation and, to lesser extent, at the depths cited. Otherwise, such constituents would have had to be discharged either to ground or surface waters. The fact that background levels have been exceeded in no way demonstrates that the soil's capacity for assimilation has been reached. The regulation should establish "safe levels" at which constituents can be applied and assimilated.

- The requirement that operations be discontinued until the Regional Admiministrator determines what actions are to be taken is unnecessarily strict and violates due process. It is too stringent because it ignores the possibility of analytical error, the importance of the finding in the particular circumstance, and the consequences of the close-down decision. It should be sufficient to require immediate notice to the Administrator and, perhaps, the requirement to conduct more frequent sampling and analysis. The

Regional Administrator always has recourse to the imminent danger provisions of RCRA Section 7003. The proposal violates due process rights of the owner/operator, as no standards are established for RA determinations, nor is the RA required to make his determination within a particular time. Thus, the RA has absolute discretion, both as to when he will make a decision and what the decision will be.

- Merely detecting contaminants below the zone of incorporation does not constitute a threat to ground water. The regulations seem to assume that any migration of contaminants to poses a hazard to ground water. This assumption is not true. Soil monitoring is a useful tool that should not be relied upon totally to provide ground water protection.
- In the event that a significant increase of hazardous constituents appears below the tilled depth, what is the recommended correction procedure? Complete removal and landfilling of the fill? Is it presumed that this senseless approval of land spreading of hazardous waste is an attempt to justify the advocation of extensive and almost uncontrolled sewage sludge farming?

C. Response to the Comments

1. Soil Monitoring Versus Ground-Water Monitoring

Comments received on this issue clearly favored some form of soil monitoring over ground-water monitoring, however, several commenters felt that ground-water monitoring was also necessary. These commenters contended that soil monitoring had certain limitations (e.g., low reliability) of detecting highly mobile contaminants, "and should not be solely relied upon to provide protection of our ground-water resources." The Agency recognizes that rapidly migrating contaminants could be missed by soil monitoring. Recently, researchers at Texas A&M have discovered that organic compounds migrated through field tests plots at a rate that was three times faster than water.[14] The waste applied to the test plots was API separator sludge and is commonly land treated at many oil refineries.

Additional impetus for ground-water monitoring came indirectly from the commenters who were dissatisfied with the Agency's interpretation of what constituted contamination. The regulations required remedial measures if contaminants migrated to three times the depth of the zone of incorporation. This facet of soil monitoring, which will be discussed in detail later, was considered to be arbitrary and precluded using the full capacity of the soil to attenuate waste. Ground-water monitoring, as required for landfills and surface impoundments, would provide a more consistent and clear determination of environmental impact at land treatment facilities.

Given the concern over the limitations of soil monitoring and the claim that the Agency's interpretation of contamination is arbitrary, ground-water monitoring is now required at land treatment facilities during interim status. The requirements are the same as for surface impoundments or landfills.

Besides the issues raised in the comments the Agency is requiring ground-water monitoring for three reasons. First, many of the land treatment facilities covered under interim status have not operated under the philosophy of "limited waste migration." Contaminants at these sites are likely to have already migrated beyond three times the depth of the zone of incorporation. Soil monitoring, as proposed, would provide no information on the depth, concentration, or type of contaminants that have migrated beyond the depth to which soil cores are taken. Second, at existing facilities new unsaturated zone monitoring (both soil and soil-pore water monitoring) is not reliable in indicating if contaminants have already migrated to ground water and what impact they may have on ground water. The only sure way to know at existing facilities is to monitor ground water. Third, soil monitoring will be used as an indicator of how well the treatment process is working. As a result, the soil monitoring requirements have been modified to provide more flexibility than the proposed regulations. These changes and the rationale for them are discussed below.

2. Soil Monitoring

Responses to the comments on the proposed soil monitoring regulations are discussed collectively to facilitate presentation of the revised monitoring scheme for land treatment facilities.

One of the most prevalent points made by commenters was that the sampling frequency should be other than one core per acre. Most of the commenters felt that the one soil core per acre requirement was excessive and the cost exorbitant. Several alternative sampling schemes were suggested, including:

- The number of soil cores should be variable until more research can be performed.
- A minimum of 10 cores and not less than one core per acre should be required, regardless of site size.
- An incentive to take more than one core per acre could be provided by making what constitutes a significant increase, a function of sample size, i.e., if one core per acre is taken, then an increase in the level of a contaminant of 1.2 times background would be considered a significant increase: if two cores per acre were taken, then a significant increase would be 1.4 times background, etc.
- For landfarms of 50 acres or less, take one core near each corner of the site and one from the center.
- Take one soil core per 10 acres, but not less than one soil core per treated area.

- The number of soil cores taken per acre should be a function of landfarm size, e.g.,:

Landfarm Size (in acres)	Core Per Unit Area
5	1 core/acre
6-9	1 core/1.5 acres
10-30	1 core/2 acres
31-60	1 core/3 acres
>60	1 core/4 acres

- Allow compositing of samples taken at one core per acre in areas where only one type of waste or waste mix is applied at a uniform rate.

Each of the above proposed sampling schemes, as well as the approach proposed in the regulations, is deficient in not being linked to a test of statistical significance for comparison with background levels. The Agency felt that the soil monitoring scheme had to have a statistical basis since it was a regulatory tool used in determining if punitive action would be taken against a facility. Because of the Agency's decision to require ground-water monitoring at land treatment facilities, soil monitoring will not play a punitive role during interim status. Soil monitoring will still be required, however, it will be structured differently and will be used to determine the effectiveness of the land treatment process.

Commenters suggested analyzing for tracers or indicator substances, rather than for the broader range of hazardous components that could be in a waste. Cost was cited as a reason for this suggestion. Lack of sufficient analytical capacity and procedures was also mentioned. It was suggested that due to waste degradation, the form of chemical components might change, making it uncertain what actual hazardous constituents were present.

The Agency does not agree that there is a lack of analytical capacity of procedures to carry out a comprehensive analysis. No evidence was presented to support that contention, and the experience of the Agency strongly suggests that this is not the case.

The point about waste degradation may well be valid particularly regarding organic wastes. Ideally, one would have sufficient data on land treatment to predict the degradation products and include them in the waste analysis. Unfortunately, such data is not available, but the revised soil analysis requirements should begin to develop such information. Some predictions of degradation products possibly could be made during the permit process on a case-by-case basis. However, during the interim status period, such interaction is not possible. Thus, for interim status, the Agency sees no reasonable solution to the problem of degradation products.

Use of indicator substances does have merit from a cost and simplicity standpoint. Conceptually, if one could select a substance in the waste which was known to migrate in the soil at least as rapidly as any other substances in the waste, then it could be monitored as an indicator. If that substance was detected as having migrated, then a more comprehensive analysis for other substances should be carried out.

However, the Agency has decided not to allow use of indicator substances during interim status. One reason is that the Agency has not yet been able to devise a set of indicator substances that reflect the success of waste treatment in the soil. During the permitting process, an owner or operator could present data to the Agency supporting a particular indicator for a particular situation. However, this interaction is not possible during interim status.

The second major reason for rejecting indicator substances is that in order to specify proper permit conditions, the Agency needs the information which would come from a more comprehensive analysis. One of the major difficulties with developing land treatment regulations is that it is a relatively new waste management process, and there is limited data on the manner in which waste so treated is rendered safe to human health and the environment. Thus, knowledge of how all of the hazardous constituents in the waste are moving in the soil is important to the coming permitting process. It is possible that the information gathered by the time the permit is to be issued will support the use of one or more indicator substances. The Agency believes that the constituents to be monitored under §265.273 are sufficiently few as not to cause undue burden.

The issues of soil-core depth and corrective action are discussed together since they are closely related. The regulations proposed that soil cores be taken to a depth of three times the zone of incorporation. If migration of contaminants was detected, as indicated by an increase in waste constituents over background levels in the bottom one-third of the core, then the owner or operator was to cease operation in the affected area, notify the Regional Administrator, and determine corrective action.

Some commenters objected to the monitoring depth of three times the zone of incorporation as being less desirable than a fixed core depth. Three feet was suggested. It was argued that depth of tillage was not relevant in determining environmental performance. In contrast, several commenters felt the support for the proposed monitoring depth was appropriate.

The proposed monitoring depth was critized for the corrective action required if migration to that depth occurred. Commenters argued that the fact that migration to the specified depth had occurred was not an indication of actual or potential environmental damage, and that the corrective action proposed was overly stringent and unjustified.

In consideration of the comments received on soil monitoring, and upon further analysis of the alternatives avaliable the Agency has revised its approach to monitoring the environmental performance of land treatment facilities. The environmentally sensitive nature of land treatment requires the owner or operator to have an accurate picture of the treatment process at work in the soil. EPA has decided that such an objective requires a more comprehensive monitoring plan than was proposed. Consequently, the new monitoring plan will be more comprehensive than previously proposed. The plan will require soil monitoring, using soil cores, and in addition, the owner or operator will be required to monitor the soil-pore water, using lysimeters or similar devices. This new monitoring scheme, now called "unsaturated zone (zone of aeration)" monitoring, although requiring an additional type of monitoring, is structured so that it will provide the owner or operator with the flexibility necessary to develop a site-specific monitoring plan.

Although lysimeter monitoring was not proposed, it is necessary, because, as commenters pointed out, soil monitoring will not detect rapidly migrating waste constituents. Given the comments on contaminant migration, and indications from an EPA-sponsored study that some organic compounds are apparently capable of rapid migration[14], it is evident that soil monitoring may not adequately detect contaminant migration and that soil-pore water monitoring may also be needed. The need for more comprehensive monitoring is further justified by the fact that land treatment facilities characteristically lack liners.

Unlike landfills and surface impoundments the use of lysimeters or similar devices is feasible at land treatment sites. Lysimeters can be installed at land treatment facilities in the area where waste has been applied. This is not practical for existing surface impoundments and landfills. In addition, the relatively shallow depth of waste application at land treatment facilities permits lysimeters to be replaced at both existing and new facilities, when they become clogged or otherwise nonfunctional. Furthermore, land treatment facilities do not have artificial liners which would interfere with the placement of lysimeters. The advantage of monitoring soil-pore water is that this type of monitoring will detect contaminants passing through the soil, whereas soil monitoring does not detect what passes through, but what has been left behind. The timing of soil-pore water sampling is very important. The sample(s) must be taken when soil-pore water from waste application is present in the sampling device. This is a function of when the waste is applied, the water content of the waste, precipitation, soil permeability, and depth of the lysimeter.

Soil-pore water monitoring in combination with soil and ground-water monitoring will provide comprehensive knowledge about the performance of the facility and its ability to protect ground water. This monitoring approach will also provide information on the mass balance (i.e., location, distribution, concentration) of contaminants in the soil system. This type of information is not only necessary from a regulatory (environmental performance) standpoint, but is requisite to understanding how a land treatment system functions. Using the monitoring data as feedback on the performance of a site, an owner or operator can more effectively manipulate operating variables in order to optimize the performance of the site (e.g., waste application rates, tilling frequency, and pH controls).

The regulations for unsaturated zone monitoring are structured, as discussed previously, to provide the owner or operator with the flexibility necessary to design a monitoring program which takes into account site-specific factors. The regulation includes a list of factors and relationships that must be taken into account when developing the plan. The owner or operator must maintain all data collected and make it available for review upon request by the Regional Administrator, and must submit all the data in conjunction with Part B of the application for a permit in accordance with Section 122, Subparts A and B. The unsaturated zone monitoring information will be particularly useful in developing the closure and post-closure care plans. This approach is intended to accommodate inherent differences between sites, and stimulate innovation of more efficient monitoring methods and plans.

3. Summary

The Agency has revised the monitoring requirements at hazardous waste land treatment facilities. Because of concerns raised by some commenters over the inability of soil monitoring to detect highly mobile contaminants, the Agency decided to require ground-water monitoring at land treatment facilities. Further impetus for ground-water monitoring came from a need for a more clear determination of what constitutes contamination at a land treatment facility. Additionally, the Agency needed a mechanism for evaluating the total impact that interim status land treatment facilities had on the environment. This evaluation was considered necessary in light of the fact that most land treatment facilities have not operated under the previously proposed philosophy of limited waste migration.

Significant changes were made to the proposed soil monitoring regulations in response to both public and in-house comments. The proposed soil monitoring scheme has been replaced with a more comprehensive unsaturated zone monitoring scheme. Soil-pore water monitoring, using lysimeters or similar devices is required in addition to soil monitoring. Although the new scheme is more comprehensive than the proposed regulations, it is structured to give the owner or operator the flexibility necessary to develop a site-specific monitoring plan.

D. Final Regulatory Language

§265.278 Unsaturated Zone (zone of aeration) Monitoring
[Interim Final]

(a) The owner or operator must have in writing, and must implement, an unsaturated zone monitoring plan which is designed to:

(1) Detect the vertical migration of hazardous waste and hazardous waste constituents under the active portion of the land treatment facility, and

(2) Provide information on the background concentrations of the hazardous waste and hazardous waste constituents in similar but untreated soils nearby; this background monitoring must be conducted before or in conjunction with the monitoring required under paragraph (a)(1) of this Section.

(b) The unsaturated zone monitoring plan must include, at a minimum:

(1) Soil monitoring using soil cores, and

(2) Soil-pore water monitoring using devices such as lysimeters.

(c) To comply with paragraph (a)(1) of this Section, the owner or operator must demonstrate in his unsaturated zone monitoring plan that:

(1) The depth at which soil and soil-pore water samples are to be taken is below the depth to which the waste is incorporated into the soil;

(2) The number of soil and soil-pore water samples to be taken is based on the variability of:

(i) The hazardous waste constituents (as identified in §265.273(a) and (b) in the waste and in the soil; and

(ii) The soil types(s); and

(3) The frequency and timing of soil and soil-pore water sampling is based on the frequency, time, and rate of waste application, proximity to ground water, and soil permeability.

(d) The owner or operator must keep at the facility his unsaturated zone monitoring plan, and the rationale used in developing this plan.

(e) The owner or operator must analyze the soil and soil-pore water samples for the hazardous waste constituents that were found in the waste during the waste analysis under §265.273 (a) and (b). [Comment: As required by §265.73, all data and information developed by the owner or operator under this Section must be placed in the operating record of the facility.]

5. Issue: Recordkeeping and reporting

A. Proposed Regulations and Rationale

The proposed regulations included in §250.45-5, recordkeeping and reporting requirements, are applicable to all treatment, storage, and disposal facilities, including land treatment. The requirements included: an operating log, a record of the quantity and description of each waste received, locations in the facility where each waste was treated or disposed and methods and dates of treatment or disposal, the results of the waste analysis performed, monitoring data, reports of visual inspections, and records of incidents requiring initiation of a contingency plan.

The rationale for these requirements is presented in the background document dealing with the manifest, recordkeeping, and reporting requirements of the interim status regulations.

B. Comments/Respoonse to Comments

Comments on the proposed recordkeeping and reporting requirements are discussed in the background document on Manifest System, Recordkeeping and Reporting. In structuring the final interim status regulations, the Agency has elected to include some of the proposed recordkeeping requirements in the sections of the regulations which address specific types of facilities. Such recordkeeping is needed to allow the owner or operator and the Regional Administrator to evaluate the facility's compliance with other requirements of the land treatment Subpart.

For land treatment facilities, recordkeeping requirements have been incorporated relative to the location where each different waste is placed in the facility, when it was placed there, and at what rate. This information will assist, through the use of mass-balance analysis, in determining whether the treatment objective of the facility is being met. The Agency believes that these requirements are an integral part of facility oprations. These records may be needed to assist the owner or operator in emergency situations or enforcement officials who may be called upon to investigate problems. In most cases such recordkeeping will be routinely performed to satisfy or supplement monitoring and closure requirements.

The recordkeeping requirements for land treatment facilities are not expected to be burdensome since the types of waste and treatment areas are typically limited at any one land treatment facility.

Additional recordkeeping requirements relative to results obtained from unsaturated zone monitoring, food-chain crop testing or monitoring, and monitoring or analysis carried out under the closure plan are specified in comments following certain of the land treatment regulations. The owner or operator is required to place the data and information in the operating record of the facility. A discussion of the facility operating record and the rationale for the inclusion of the data and information specified in the comments following some of the land treatment regulations is discussed in the background document on Manifest System, Recordkeeping, and Reporting.

C. Final Regulatory Language

§265.279 Recordkeeping

The owner or operator of a land treatment facility must keep records of the application dates, application rates, quantities, and location of each hazardous waste placed in the facility, in the operating required in §265.73.

6. Issue: Closure

A. Proposed Interim Status Regulations and Rationale

The proposed regulations provided two basic options for closure of a land treatment facility. One option was to return the soil in the treated area to its prexisting condition, as determined by background soil analysis or analysis of similar local soils. The other option was to remove the contaminated soil from the facility if that soil met the characteristics of a hazardous waste. (If it did not fail the hazardous waste characteristics, no further action was required.) However, a variance to the second option provided an option to close the facility as a landfill if the owner or operator could demonstrate that the design or location provided long-term integrity and environmental protection equivalent to a landfill, as specified in the proposed regulations.

One objective of the requirement to return the soil to its preexisting condition or remove it, was to prevent the conversion of huge tracts of productive land to land having limited potential for future use. In addition, the Agency has limited data on the fate and long-term effects of the hazardous contaminants in a land treatment facility. There was concern that the contaminants would eventually be carried away by surface runoff or would migrate to ground water.

There was some precedent in state regulations for the proposed approach. The Texas Department of Natural Resources incorporates a similar approach in some of the permits issued for land treatment facilities. If the results of tests comparing the leachate from treated soil with untreated soil suggest a potential threat of hazard to surface water, the Texas DNR requires the removal of soil to a depth of 12 inches.

The variance for closure as a landfill was based on the assumption that if appropriate liners, monitoring, and cover were provided, the facility would not present a significant potential for environmental damage. While this and the other closure options take a conservative posture on closure, the Agency felt that it had no information to suggest that other approaches would be protective. This is due to the fact that, to the knowledge of EPA, no hazardous land treatment facility has been closed to date.

B. Comments on the Proposed Regulations

1. Return of Soil to Original Condition

- Requiring return of soil to its original condition is beyond RCRA authroity. There is nothing in RCRA or its legislative history to support this requirement.
- Land treatment may improve some soils, so return to original condition would be considered counterproductive.
- Requiring that land be returned to its original condition is unreasonable, impractical, and prohibitivly expensive and will eliminate land treatment.
- The regulations should consider return to productive use, i.e., capable of supporting indigenous vegetation.

- The term "preexisting conditions" is vague and indefinite, and the regulations fail to establish standards by which the condition of the land upon closure may be established.

- Return to original soil condition is unnecessary because land treatment facilities can be returned to productive use as long as levels of contaminants in the soil are not a problem for those uses, and the amount of land used or contemplated is not a significant portion of productive land.

- Requiring return of the soil to its preexisting condition discriminates against industry, since land treatment of POTW sludges has no such restrictions.

2. Use of the Extraction Procedure* (EP) on Soil

- The EP may not appropriately identify contaminated soil. It will underestimate the contamination of the soil, since it does not test for all hazardous contaminants, only those in the EPA Drinking Water Standards.

- The dcecision to remove soil should include factors such as: the chemical and physical characteristics of the contaminants, the soil's ability to support vegetation, the potential for erosion, the site location, and the intended future use of the land.

- The EP is not appropriate for clay soils, which often contain cadmium and selenium in their natural state. Thus, the EP may show virgin soil to be hazardous.

- Should use water rather than the acid in the soil EP because water is the "natural leachant" from precipitation and runoff.

- Naturally-occurring soils would fail the EP (data not provided).

3. Soil Removal: Closure as a Landfill

- The potential expense of removal of soil or closure as a landfill is extreme and would create a serious threat to land treatment of industrial wastes.

- To remove and landfill the soil in a land treatment facility would so increase the overall cost of land treatment that it would become economically noncompetitive with a landfill or other disposal options. This would eliminate land treatment as a disposal method. (No data provided.)

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*The Extraction Procedure is described i §250.13(d) of Subpart A in the December 19, 1978, proposed regulations.

- The removal of soil can result in problems of accelerated erosion that would negate any questionable advantage of removal.

4. Suggested Alternative Closure Requirements

- Soil should be allowed to remain only when soil erosion is negligible for 50 to 100 years and an impermeable soil structure exists.
- Closure regulations should specify the objective of closure, when it should begin, and certain minimum conditions. Determination of when closure should begin should be based on waste characteristics and soil properties, particularly assimilation capacity. It is recommended that closure regulations require:
  - closure so that no further maintenance is necessary
  - treating the soil to achieve a pH of 6.5 (minimum)
  - vegetable cover
  - control of erosion; maintenance of dikes
  - removal of any soil incapable of supporting vegetation or which presents a threat to human health and the environment
- Should consider specifying pH maintenance and other "onsite" measures to prevent migration.
- Should require only soil monitoring for closure because return to original condition is too difficult, and removal would not eliminate the disposal problem. Additional protection could be provided by the type of soil and the berm around the treated area.
- Should not look at the increase of contaminants in the soil, but whether the soil presents a hazard to ground water or whether crops grown on the soil would have dangerously elevated concentrations.
- Closure should relate to the level of potential environmental harm.
- Closure should require prevention of escape of absorbed metals by runoff, plant uptake, or wind.
- Should leave closure design criteria to the owner/operator, since proper design is site-specific.

- It is not true that, left unattended, contaminants of the soil filter media will eventually be carried off by surface runoff or will migrate to ground water. It is also not true that such occurrences will be significant, especially if plant cover is established. Under some conditions, soil should be left as it is.

- EPA's position for soil removal is inconsistent since EPA admits no documented cases of ground-water contamination, yet says that if soil is left unattended, contaminants will eventually migrate.

C. Response to the Comments

1. Return of Soil to Preexisting Condition

The Agency agrees with may of the points made by commenters and has removed this requirement from the final regulations. There was a stong consensus in the comments that such a requirement was impractical and would effectively terminate land treatment as a waste management option. Furthermore, the Agency was unable to identify methods of returning soil to its preexisting condition, or to adequately define how the Agency would judge whether this has been achieved. The Agency also concluded that this was not a necessary condition for future productive use of the land. Finally, and most importantly, the Agency believes that alternative closure requirements which are more practical can achieve protection of the environment.

2. Use of the Extraction Procedure (EP)

The proposed regulations referred to the extraction procedure (EP), defined in Subpart A of the proposed regulations, as the method to determine if soils in a land treatment facility are hazardous at the time of closure. If the EP showed the soil to be hazardous then the owner or operator was to close the site by either removing the contaminated soil or closing the site as a landfill.

Comments on the use of the EP suggested it was inappropriate, but for diametrically opposite reasons. Some commenters felt the EP would underestimate contamination because it covered only a few contaminants, while other commenters felt the EP would overestimate the contamination of the soil because it was to harsh on extractant.

Two commenters expressed concern that the EP would show certain virgin soils to be hazardous. No data was provided to corroborate the comments.

Based upon the comments and a reevaluation of its position, the Agency found that the EP, as proposed in Subpart A, is not appropriate as the sole indicator of whether the soil should be removed or the facility closed like a landfill.

The Agency considered altenative soil tests, but was unable to identify any which had both broad application and the ability to unequivocally indicate that the soil of a land treatment facility is contaminated to the extent it would need to be removed.

The major drawback of using a simple soil test is that it does not take into account the various extrinsic factors that play an integral role in determining the hazard posed by the soil. This part was made in the comments. One commenter suggested that the decision to remove the soil of a land treatment facility should include factors other than the EP results. The following factors were identified: chemical and physical characteristics of the contaminants, the soil's ability to support vegetation, the potential to support vegetation, the potential for erosion, site location, and intended future use of the land.

The Agency has decided to use an approach similar to the one suggested in the comments. The Agency has identified four environmental objectives and a number of factors that the owner or operator of a land treatment facility should consider to meet the objectives, when deciding on the disposition of the soil from the active portion(s) of the site. A detailed discussion is presented below.

3. Waste Removal: Closure as a Landfill

Although most of the closure comments focused on return of the soil to its preexisting condition, a few comments addressed waste removal and closure as a landfill. The tenor of these comments was that these requirements would be too costly and would make land treatment noncompetitive. No data were provided to support these claims.

The Agency agrees that these proposed closure options will result in increased costs for land treatment. However, the contention that land treatment will become noncompetitive as a result of cost is not tenable. The cost of all waste management practices will increase as a result of the Subtitle C regulations, and the Agency expects land treatment to remain a viable waste management otion for certain waste streams. Additionally, it is not the objective of the closure regulations to ensure that land treatment remains competitive, in the economic sense. Rather, the objective is to ensure that the closure requirements prevent the dispersion of contaminants into the environment.

The real issue is whether there is a need for such a restrictive approach. Because of the dearth of information available on closing land treatment facilities, and the relatively young age of this waste managment practice, the Agency has not been able to unequivocably demonstrate the need for such a restrictive and rigid closure approach. As a result, the Agency has removed these closure requirements from the final regulations in favor of a more flexible approach, described below.

4. Alternative Closure Approaches

A number of alternative closure approaches were suggested in the comments. Many of these approaches may have merit in a given situation. Most depend on a case-by-case assessment.

The Agency believes that it is both feasible and desirable to base the closure requirements on such individual assessments. The owner or operator should be allowed to make a case that a given closure procedure will suit his particular situation and provide adequate environmental protection. This type of approach is necessary because of the current lack of experience with land-treatment closure and the consequent lack of a data base to adequately support particular closure requirements.

Therefore, the Agency has substantially revised the closure requirements for land treatment facilities. The new requirements specify that the owner or operator must develop and implement a facility closure plan. The terms of that plan are enforceable against the owner or operator. The plan must address four objectives: (1) controlling the migration of hazardous waste and hazardous waste constituents into ground water; (2) controlling the release of contaminated runoff to surface water; (3) controlling the release of airborne particulate contaminants; and (4) compliance with the standards established for food-chain crops. In meeting these objectives the owner or operator must consider a range of factors affecting th facility's ability to meet the objectives. Relative to ground-water protection, these factors include: depth to ground water; ground-water use; geological profile; amount and pH of precipitation; type, concentration, and extent of migration of contaminants in the soil; expected rate of contaminant migration including any data from laboratory leaching studies using the soil in the facility; soil characteristics, including cation exchange capacity, total organic carbon, and pH; feasibility of removing the contaminated soil at a later time if migration continues and appears like to contaminant ground water; comprehensiveness of proposed monitoring following closure; and proposed post-closure care, including maintenance of unsaturated zone monitoring, restricting site access, and future land use.

Relative to surface water protection, the factors include: surrounding geography and land use, surrounding surface water uses and quality, amount and pH of rainfall, use of cover or vegetation to minimize erosion of contaminated soil, maintenance of diversion structures to prevent surface runoff from entering the active portion(s), facilities for collecting and treating any runoff, etc.

Regarding wind erosion, the Regional Admnistrator will evaluate the use of vegetation or cover to prevent soil erosion and control the release of airborne particulate contaminants.

The owner or operator must also develop a post-closure care plan. The terms of this plan are also enforceable against the owner or operator. Under these interim status regulations the post-closure care plan must provide for maintenance of monitoring systems, restriction of access as appropriate for post-closure use, and control of the growth of food-chain crops to the same degree as required for an active facility.

D. Final Regulatory Language

§ 265.280 Closure and post-closure [Interim Final]

(a) In the closure plan under §265.112 and the post-closure plan under §265.118, the owner or operator must address the following objectives and indicate how they will be achieved:

(1) Control of the migration of hazardous waste and hazardous waste constituents from the treated area into the ground water;

(2) Control of the release of contamnated run-off from the facility into surface water;

(3) Control of the release of airborne particulate contaminants caused by wind erosion; and

(4) Complaince with §265.276 concerning the growth of food-chain crops.

(b) The owner or operator must consider at least the following factors in addressing the closure and post-closure care objectives of paragraph (a) of this Section:

(1) Type and amount of hazardous waste and hazardous waste constituents applied to the land treatment facility;

(2) The mobility and the expected rate of migration of the hazardous waste and hazardous waste constituents;

(3) Site location, topography, and surrounding land use, with respect to the potential effects of pollutant migration (e.g., proximity to ground water, surface water and drinking water sources);

(4) Climate, including amount, frequency, and pH of

precipitation;

(5) Geological and soil profiles and surface and subsurface hydrology of the site, and soil characteristics, including cation exchange capacity, total organic carbon, and pH;

(6) Unsaturated zone monitoring information obtained under §265.278; and

(7) Type, concentration, and depth of migration of hazardous waste constituents in the soil as compared to their background concentrations.

(c) The owner or operator must consider at least the following methods in addressing the closure and post-closure care objectives of paragraph (a) of this Section:

(1) Removal of contaminated soils

(2) Placement of a final cover, considering:

(i) Functions of the cover (e.g., infiltration control, erosion and runoff control, and wind erosion control), and

(ii) Characteristics of the cover, including material, final surface contours, thickness, porosity and permeability, slope, length of run of slope, and type of vegetation on the cover;

(3) Collection and treatment of runoff;

(4) Diversion structures to prevent surface water runon from entering the treated area; and

(5) Monitoring of soil, soil-pore water, and ground water.

(d) In addition to the requirements of §265.117, during the post-closure care period, the owner or operator of a land treatment facility must:

(1) Maintain any unsaturated zone monitoring system, and

collect and analyze samples from this system in a manner and frequency specified in the post-closure plan;

(2) Restrict access to the facility as appropriate for its post-closure use; and

(3) Assure that growth of food-chain crops complies with §265.276.

7. Issue: Special Requirements for Ignitable, Reactive and Incompatible Wastes

A. Proposed Regulations and Rationale

The proposed regulations prohibited placing ignitable, reactive, volatile, and incompatible wastes in a land treatment facility, but allowed a variance if the owner or operator could demonstrate that airborne contaminants would not exceed a specified concentration, and that the attenuation capacity of the facility would not be adversely affected through heat generation, fires, or explosions.

This regulation, although not proposed as an interim status standard, meets the criteria established by the Agency for interim status standards.

The objective of the proposed regulation was to prevent damages to human health and the environment which could result from fires or explosions in a land treatment facility. Placing ignitable or reactive wastes in a land treatment facility presents at least two potential problems.

One problem is the contamination of the air through volatilization, since most ignitable and some reactive wastes have relatively high vapor pressures. A second problem is that ignitable and reactive wastes can explode or burn easily, injuring the personnel at the facility and releasing toxic fumes that can reach surrounding populations and cause personal and property damage. Fires and explosions can also adversely affect the attentuation capacity of the facility.

A recent study[2] has shown that, during land treatment operations, fires and explosions can occur. Potential ignition sources include electrical sparks from machinery operating on the facility, accidents or errors such as smoking near the facility, and extreme heat generation from reactive or incompatible sources.

Mixing of hazardous wastes that are not compatible with each other in a hazardous waste land treatment facility can result in similar types of environmental problems. Such mixing can cause fires and explosions, excessive heat generation, or generation of toxic gases. This could endanger facility personnel or populations in the vicinity of the impoundment, or it could adversely affect the attentuation capacity of the facility.

B. Comments on the Proposed Regulations

The restrictions on ignitable, reactive, and incompatible wastes in the proposed regulations went beyond land treatment. Similar restrictions were included in the proposed regulations for all treatment and disposal facilities under §265.22, and standards for basins under §250.45-5. The background documents dealing with those standards contain additional analysis of comments on this issue.

Those comments directed specifically toward land treatment facilities are as follows:

- The restriction on ignitables should be revised to allow land treatment if the waste is no longer ignitable after incorporation into the soil.

- Many hazardous wastes classified as ignitable or reactive, or which are incompatible when combined, may lose these properties when mixed with the soil due to dilution, absorption, or other mechanisms. Thus land treatment of such wastes should not be prohibited.
- A land treatment facility can act as a destruction mechanism, rendering a waste nonhazardous through slow oxidation. Ignitable, nitrated organics are particularly amenable to slow oxidation in soils. This would be a safer disposal method than rapid oxidation through incineration. The hazard of most concern is placing the material without incident during handling. An absolute prohibition against land treatment of ignitables, reactives, or incompatibles in any concentrations or quantities is inappropriate.
- Land treatment is an attractive way to dispose of hazardous oily wastes. The exclusion of land treatment of ignitables should be lifted. This can be done safely with little or no fire hazard.
- The proposed regulations will preclude land treatment as a viable alternative, since many wastes are ignitable, reactive, or volatile, and corrosive wastes cannot be land treated due to pH. The variance is not likely to be viewed favorably by permit officials.

C. Response to the Comments

Relevant to the discussion of the comments above is the fact that the Agency, in response to comments on the variance in §250.45(c) dealing with volatility, has found it necessary to defer any requirements relative to controls on volatiles. Similarly, the variance in §250.45(c) regarding concentration of airborne contaminants has been deferred and will be reconsidered when the Agency addresses restrictions on volatile waste. The reader is referred to the background document on tanks and basins for further discussion of this issue.

The comments on ignitable waste suggest that incorporation of such wastes into the soil is, in itself, an effective way of rendering these wastes nonignitable. The Agency concurs with this suggestion. However, as a comment suggested, the safety of handling the waste, i.e., incorporating it into the soil, is still an issue. However, the Agency has no damage cases indicating that this has been a problem in practice up to this time. Nevertheless, one way of eliminating or reducing this handling hazard would be to treat or mix the waste prior to land treatment, so that the resulting material is no longer ignitable. This practice would provide the greatest margin of safety.

A similar logic would apply to land treatment of reactive or incompatible wastes. In an attempt to find a method of rendering such wastes nonreactive, the Army Material Development Command, at Edgewood Aresenal in Natick, Massachusetts has safely land-treated reactive wastes.[35] While other characteristics of the particular waste, (i.e., nonbiodegradability), reduced the attractiveness of land treatment, safe handling, and rendering the wastes nonreactive did seem possible.

In view of these considerations, the regulations have been revised to include conditions under which such wastes can be land treated.

D. Final Regulatory Language

§265.281 Special requirements for ignitable or reactive waste

Ignitable or reactive wastes must not be land treated, unless the waste is immediately incorporated into the soil so that (1) the resulting waste, mixture, or dissolution of material no longer meets the definition of ignitable or reactive waste under §§261.21 or 261.23 of this chapter, and (2) §265.17(b) is complied with.

§265.282 Special requirements for incompatible wastes

Incompatible wastes, or incompatible wastes and materials, (see Appendix V for examples) must not be placed in the same land treatment area, unless §265.17(b) is complied with.

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APPENDIX A

INTERIM STATUS STANDARDS
FOR LAND TREATMENT

Subpart M - Land Treatment

§265.270 Applicability

The regulations in this Subpart apply to owners and operators of hazardous waste land treatment facilities, except as §265.1 provides otherwise.

[§265.271 Reserved]

§265.272 General operating requirements [Interim Final]

(a) Hazardous waste must not be placed in or on a land treatment facility unless the waste can be made less hazardous or non-hazardous by biological degradation or chemical reactions occurring in or on the soil.

(b) Run-on must be diverted away from the active portions of a land treatment facility.

(c) Run-off from active portions of a land treatment facility must be collected.

[Comment: If the collected run-off is a hazardous waste under Part 261 of this Chapter, it must be managed as a hazardous waste in accordance with all applicable requirements of Parts 262, 263, and 265 of this Chapter. If the collected run-off is discharged through a point source to waters of the United States, it is subject to the requirements of Section 402 of the Clean Water Act, as amended.]

(d) The date for compliance with paragraphs (b) and (c) of this Section is 12 months after the effective date of this Part.

§265.273 Waste analysis

In addition to the waste analyses required by §265.13, before placing a hazardous waste in or on a land treatment facility, the owner or operator must:

(a) Determine the concentrations in the waste of any substances which exceed the maximum concentrations contained in Table I of §261.24 of this Chapter that cause a waste to exhibit the EP toxicity characteristic;

(b) For any waste listed in Part 261, Subpart D, of this Chapter, determine the concentrations of any substances which caused the waste to be listed as a hazardous waste; and

(c) If food chain crops are grown, determine the concentrations in the waste of each of the following constituents: arsenic, cadmium, lead, and mercury, *unless* the owner or operator has written, documented data that show that the constituent is not present.

[*Comment*: Part 261 of this Chapter specifies the substances for which a waste is listed as a hazardous waste. As required by §265.13, the waste analysis plan must include analyses needed to comply with §§265.281 and 265.282. As required by §265.73, the owner or operator must place the results from each waste analysis, or the documented information, in the operating record of the facility.]

[§265.274 Reserved]

[§265.275 Reserved]

§265.276 Food chain crops [Interim Final]

(a) An owner or operator of a hazardous waste land treatment facility on which food chain crops are being grown, or have been grown and will be grown in the future, must notify the Regional Administrator within 60 days after the effective date of this Part.

[Comment: The growth of food chain crops at a facility which has never before been used for this purpose is a significant change in process under §122.23(c)(3) of this Chapter. Owners or operators of such land treatment facilities who propose to grow food chain crops after the effective date of this Part must comply with §122.23(c)(3) of this Chapter.]

(b)(1) Food chain crops must not be grown on the treated area of a hazardous waste land treatment facility unless the owner or operator can demonstrate, based on field testing, that any arsenic, lead, mercury, or other constituents identified under §265.273(b):

(i) Will not be transferred to the food portion of the crop by plant uptake or direct contact, and will not otherwise be ingested by food chain animals (e.g., by grazing); or

(ii) Will not occur in greater concentrations in the crops grown on the land treatment facility than in the same crops grown on untreated soils under similar conditions in the same region.

(2) The information necessary to make the demonstration required by paragraph (b)(1) of this Section must be kept at the facility and must, at a minimum:

(i) Be based on tests for the specific waste and application rates being used at the facility; and

(ii) Include descriptions of crop and soil characteristics, sample selection criteria, sample size determination, analytical methods, and statistical procedures.

(c) Food chain crops must not be grown on a land treatment facility receiving waste that contains cadmium unless all requirements of paragraph (c)(1)(i) through (iii) of this Section or all requirements of paragraph (c)(2)(i) through (iv) of this Section are met.

(1) (i) The pH of the waste and soil mixture is 6.5 or greater at the time of each waste application, except for waste containing cadmium at concentrations of 2 mg/kg (dry weight) or less;

(ii) The annual application of cadmium from waste does not exceed 0.5 kilograms per hectare (kg/ha) on land used for production of tobacco, leafy vegetables, or root crops grown for human consumption. For other food chain crops, the annual cadmium application rate does not exceed:

Time Period	Annual Cd Application Rate (kg/ha)
Present to June 30, 1984	2.0
July 1, 1984 to Dec. 31, 1986	1.25
Beginning Jan. 1, 1987	0.5

(iii) The cumulative application of cadmium from waste does not exceed the levels in either paragraph (c)(1)(iii)(A) of this Section or paragraph (c)(1)(iii)(B) of this Section.

(A)

Soil cation exchange capacity (meq/100g)	Maximum cumulative application (kg/ha)	
	Background soil pH less than 6.5	Background soil pH greater than 6.5
less than 5	5	5
5-15	5	10
greater than 15	5	20

(B) For soils with a background pH of less than 6.5, the cumulative cadmium application rate does not exceed the levels below: Provided, that the pH of the waste and soil mixture is adjusted to and maintained at 6.5 or greater whenever food chain crops are grown.

Soil cation exchange capactiy (meq/100g)	Maximum cumulative application (kg/ha)
less than 5	5
5-15	10
greater than 15	20

(2) (i) The only food chain crop produced is animal feed.

(ii) The pH of the waste and soil mixture is 6.5 or greater at the time of waste application or at the time the crop is planted, whichever occurs later, and this pH level is maintained whenever food chain crops are grown.

(iii) There is a facility operating plan which demonstrates how the animal feed will be distributed to preclude ingestion by humans. The facility operating plan describes the measures to be taken to safeguard against possible health hazards from cadmium entering the food chain, which may result from alternative land uses.

(iv) Future property owners are notified by a stipulation in the land record or property deed which states that the property has received waste at high cadmium application rates and that food chain crops should not be grown, due to a possible health hazard.

[Comment: As required by §265.73, if an owner or operator grows food chain crops on his land treatment facility, he must place the information developed in this Section in the operating record of the facility.]

[§265.277 Reserved]

§265.278 Unsaturated zone (zone of aeration) monitoring [Interim Final]

(a) The owner or operator must have in writing, and must implement, an unsaturated zone monitoring plan which is designed to:

(1) Detect the vertical migration of hazardous waste and hazardous waste constituents under the active portion of the land treatment facility, and

(2) Provide information on the background concentrations of the hazardous waste and hazardous waste constituents in similar but untreated soils nearby; this background monitoring must be conducted before or in conjunction with the monitoring required under paragraph (a)(1) of this Section.

(b) The unsaturated zone monitoring plan must include, at a minimum:

(1) Soil monitoring using soil cores, and

(2) Soil-pore water monitoring using devices such as lysimeters.

(c) To comply with paragraph (a)(1) of this Section, the owner or operator must demonstrate in his unsaturated zone monitoring plan that:

(1) The depth at which soil and soil-pore water samples are to be taken is below the depth to which the waste is incorporated into the soil;

(2) The number of soil and soil-pore water samples to be taken is based on the variability of:

(i) The hazardous waste constituents (as identified in §265.273(a) and (b)) in the waste and in the soil; and

(ii) The soil type(s); and

(3) The frequency and timing of soil and soil-pore water sampling is based on the frequency, time, and rate of waste application, proximity to ground water, and soil permeability.

(d) The owner or operator must keep at the facility his unsaturated zone monitoring plan, and the rationale used in developing this plan.

(e) The owner or operator must analyze the soil and soil-pore water samples for the hazardous waste constituents that were found in the waste during the waste analysis under §265.273 (a) and (b).

[Comment: As required by §265.73, all data and information developed by the owner or operator under this Section must be placed in the operating record of the facility.]

§265.279 Recordkeeping

The owner or operator of a land treatment facility must keep records of the application dates, application rates, quantities, and location of each hazardous waste placed in the facility, in the operating record required in §265.73.

§265.280 Closure and post-closure [Interim Final]

(a) In the closure plan under §265.112 and the post-closure plan under §265.118, the owner or operator must address the following objectives and indicate how they will be achieved:

(1) Control of the migration of hazardous waste and hazardous waste constituents from the treated area into the ground water;

(2) Control of the release of contaminated run-off from the facility into surface water;

(3) Control of the release of airborne particulate contaminants caused by wind erosion; and

(4) Compliance with §265.276 concerning the growth of food-chain crops.

(b) The owner or operator must consider at least the following factors in addressing the closure and post-closure care objectives of paragraph (a) of this Section:

(1) Type and amount of hazardous waste and hazardous waste constituents applied to the land treatment facility;

(2) The mobility and the expected rate of migration of the hazardous waste and hazardous waste constituents;

(3) Site location, topography, and surrounding land use, with respect to the potential effects of pollutant migration (e.g., proximity to ground water, surface water and drinking water sources);

(4) Climate, including amount, frequency, and pH of precipitation;

(5) Geological and soil profiles and surface and subsurface hydrology of the site, and soil characteristics, including cation exchange capacity, total organic carbon, and pH;

(6) Unsaturated zone monitoring information obtained under §265.278; and

(7) Type, concentration, and depth of migration of hazardous waste constituents in the soil as compared to their background concentrations.

(c) The owner or operator must consider at least the following methods in addressing the closure and post-closure care objectives of paragraph (a) of this Section:

(1) Removal of contaminated soils;

(2) Placement of a final cover, considering:

(i) Functions of the cover (e.g., infiltration control, erosion and run-off control, and wind erosion control), and

(ii) Characteristics of the cover, including material, final surface contours, thickness, porosity and permeability, slope, length of run of slope, and type of vegetation on the cover;

(3) Collection and treatment of run-off;

(4) Diversion structures to prevent surface water run-on from entering the treated area; and

(5) Monitoring of soil, soil-pore water, and ground water.

(d) In addition to the requirements of §265.117, during the post-closure care period, the owner or operator of a land treatment facility must:

(1) Maintain any unsaturated zone monitoring system, and collect and analyze samples from this system in a manner and frequency specified in the post-closure plan;

(2) Restrict access to the facility as appropriate for its post-closure use; and

(3) Assure that growth of food chain crops complies with §265.276.

§265.281 Special requirements for ignitable or reactive waste*

Ignitable or reactive wastes must not be land treated, unless the waste is immediately incorporated into the soil so that (1) the resulting waste, mixture, or dissolution of material no longer meets the definition of ignitable or reactive waste under §§261.21 or 261.23 of this Chapter, and (2) §265.17(b) is complied with.

§265.282 Special requirements for incompatible wastes*

Incompatible wastes, or incompatible wastes and materials, (see Appendix V for examples) must not be placed in the same land treatment area, unless §265.17(b) is complied with.

[§§265.283 - 265.299 Reserved]

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APPENDIX B

SUMMARY OF TEXAS AND OKLAHOMA LAND CULTIVATION [TREATMENT] GUIDELINES

APPENDIX B

SUMMARY OF TEXAS AND OKLAHOMA LAND CULTIVATION GUIDELINES

ITEM	GUIDELINE (SUMMARY STATEMENT)	
	TEXAS	OKLAHOMA
o Soils	o Should be deep, prefer high clay and organic content and have large surface area (best soils are classed as CL, OL, MI, CH, and OH under the Unified Soil Classification System)	o Should be deep, have large total surface area and have high clay and organic content (best soils are classed as CL, OL, MI, CH, and OH under the Unified Soil Classification System)
o Topography	o Prefer surface slopes less than 5 percent, greater than 0 percent	o Slope should be less than 5 percent greater than 0 percent
o Climate	o High net evaporation, median mean temperature, moderate 24-hr, 25-yr frequency maximum rainfall	o High net evaporation, median mean temperature, moderate 24-hr, 50-yr frequency maximum rainfall
o Surrounding Land Use	o Sparsely populated, or provide buffer and locate downwind from nearby residences	o Sparsely populated, or provide buffer and locate downwind from nearby residences
o Ground-water Conditions	o Avoid shallow, potable ground water. If not possible, provide vegetative cover, avoid high application rates, monitor ground water-quality	o Avoid shallow, potable ground water. If not possible, provide vegetative cover, avoid high application rates, rigidly monitor ground-water quality

APPENDIX B (Continued)

	GUIDELINE (SUMMARY STATEMENT)	
ITEM	TEXAS	OKLAHOMA
o Waste Restrictions	o Not addressed	o Water soluble, inorganic industrial wastes should not be land cultivated
o Application Rates	o Minimum waste composition analysis: Cl, PO_4, Total N, Zn, Cu, Ni, As, Ba, Mn, Cr, Cd, B, Pb, Hg, Se, Na, Mg, Ca	o Minimum waste composition analysis: Zn, Cu, Ni, As, Ba, Mn, Cr, Cd, O, Pb, Hg, Se, Na, Mg, Ca, Cl, PO_4, Total N
	o Determine soil cation exchange capacity (CEC)	o Determine soil CEC if any of the elements in waste composition analysis above are present
	o Total metals application over site life should be less than 50 percent of CEC of top 1 ft of site's soil.	o Not addressed
	o If crop grown and harvested at site, total metal application in 30-yr period should be less than 5 percent of CEC.	o Not addressed

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APPENDIX B (Continued)

ITEM	GUIDELINE (SUMMARY STATEMENT)	
	TEXAS	OKLAHOMA
o Application Rates (concluded)	o Total N applied in waste, less than 125 lb/ac/yr	o Total N applied in waste, no more than 125 lb/ac/yr, or the maximum amount utilized or assimilated by vegetative cover
	o Annual free water applied in the waste should be less than annual evaporation rate	o Total free water applied should be no more than the net evaporation for time period between applications
	o Not addressed	o Oily waste application rate must be such that soil-waste mixture contains no more than 10 percent oil by weight
	o Not addressed	o Recommended application rate for oily wastes at established (over 6 mo old) sites: - 35 bbl oil/ac/mo--without fertilizer - 60 bbl oil/ac/mo--with fertilizer

APPENDIX B (Concluded)

	GUIDELINE (SUMMARY STATEMENT)	
ITEM	TEXAS	OKLAHOMA
o Operational Restrictions	o All runoff must be contained (use dikes or lined control collection basin) unless discharge permit is obtained. Collection basin should contain 25-yr, 24-hr maximum rainfall	o All runoff must be contained unless discharge permit is obtained (use dikes or lined central collection basin). Collection basin must contain all site runoff from a 50-yr, 24-hr maximum rainfall
	o Soil pH must be maintained at above 6.5 while the site is active	o Soil pH must be maintained at above 6.5 while site is active
	o Mix waste into soil as soon as possible	o Mix waste into soil as soon as possible
	o Vegetation for human or animal consumption must be analyzed for metals contained in the waste before feeding.	o Vegetation for human or animal consumption must be analyzed for metals and any elements in the waste which are known to be concentrated by the plant species before use or sale
o Mixing Frequency	o Not addressed	o Dependent on rainfall. Recommended practice is to mix twice monthly for first 2 months, then once every other month
o Mixing Depth	o Not addressed	o Sludge should be mixed into soil to a depth of 6 to 12 in.